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Atlas of Chinese Macrofungal Resources

Volume 1:

Overview, Macrofungal Ascomycetes,
Jelly Fungi and Coral Fungi

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Foreword 1

Species are carriers of genes. A gene existing independently from individuals within a species has no value. A diversity of species incorporating a diversity of genes existing within a diversified ecosystem represents the core of biological diversity. Genetic diversity of genes does not exist without diversity of species. Therefore, species diversity is the most important reproductive natural resource that man has and is a treasure that humankind relies on to achieve sustainable development.

Fungi are one of the most diverse biological groups in the earth biosphere, and in term that refer to all eucaryotic fungal life forms, including the true fungi from Kingdom Fungi, chromistan fungal analogues such as the oomycetes, as well as protozoan fungal analogues such as myxomycetes. Little has been known about the diversity of fungi. A conservative estimate by specialists suggests that there are at least 2.5 million species of fungi among fungal species within the biosphere on the earth. However, only around 100,000 species have been known and denominated, leaving 96% of fungi to be discovered, recognized, denominated, described, studied and utilized. Like other microbes, fungi can be produced in factories at a large scale and developed into a large industry through the application of technology, perhaps making it the most abundant reproducible natural resource that humans count on for their sustainable development.

Chinese Fungal Resources and Exploitation, a collection of four volumes, that includes *Atlas of Chinese Macrofungal Resources*, *Production of Edible Mushrooms in China*, *Mycomedicines in China* and *Processing of Edible Mushrooms in China* is the most comprehensive compilation and collection of fungal resources and their exploitation in China today. Renowned mycologist, Academician Yu Li served as the editor-in-chief.

More than 1800 species of macrofungi are presented in the volume *Atlas of Chinese macrofungal resources*, which are the original works of the authors of this book, many are newly published, representing the latest achievements in the macrofungal researches. This volume is characterized by the concise descriptions, exquisite images and strong practicability in format that makes it an important referential tool for identification of fungal resources.

The volume *Production of Edible Mushrooms in China* systematically introduces various cultivation technologies used in the production of edible mushrooms, the fifth largest agricultural crop in China, and includes successful cases and experiences in the cultivation process.

The introductory part of the volume *Mycomedicines in China* introduces the definition, origin, development and herbalogical textual research of mycomedicines; their medicinal properties and compatible theory in traditional use, chemical composition, pharmacological action, identification, production and ethnic mycomedicines are also presented. And the following individual chapters introduce the mycomedicines, respectively, under various categories of stroma mycomedicines, sclerotium mycomedicines, fermentation mycomedicines and others.

The volume *Processing of Edible Mushrooms in China* introduces the current situation and prospects of processing fungi, and cover aspects of preservation, logistics, facilities, equipment, primary processing, complex and testing of processing quality. Examples are also given.

Sun Simiao, the ancient Chinese King of Medicine, classified the human health status into three levels: superior, intermediate and inferior, in which, free-of-illness (healthy) is superior, close-to-illness (sub-healthy) is intermediate and illness-possession (unhealthy) is inferior. In

the same way, he classified medical treatments into three levels: making humans free from illness is superior, curing almost-ill people is intermediate and curing ill people is inferior. His healing art demonstrated the broadness and profoundness of Chinese medicine and herb use long before the establishment of the theoretical system in which the prevention of illness prevails over the treatment of illness.

Modern science has proven and will continue to prove that edible mushrooms have great significance in maintaining a superior status of health in man. Therefore, while great efforts are being made into developing edible fungus industry, it is undoubtedly critical to carry on the research, development and exploitation of edible mushrooms in a broader and profounder way, while collaborating with medical and health systems, and incorporating industry, education and research sectors, in order to capitalize the achievements of the present era and create benefits for generations to come. The publication of the four-volume collection of *Chinese Fungal Resources and Exploitation* will provide guidance and reference for research, development and exploitation of edible mushrooms by incorporating the industry, education and research sectors, as well as creating the foundation for the development and innovation of fungi for the benefit of mankind.

Academician of Chinese Academy of Sciences,
Honorary chairman of the Chinese Society of Fungi,
Editor of the Editorial Committee of Chinese Spore,
Flora, Chinese Academy of Sciences,
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Jiangchun Wei

Foreword 2

When I received the invitation for preparing this foreword, I considered it as a great challenge, as for years, I have rarely written letters or articles in Chinese. While I was still hesitating, something said by Dr. Sam Nujoma, former president of Namibia accidentally came into my mind: “I always take challenges as opportunities to learn new things”. Indeed, I did run into many difficulties and challenges when writing this foreword, especially typing in Chinese using Pinyin (a romanization system for Standard Mandarin Chinese). On the other hand, I did learn a lot of new things because of the opportunities offered by this challenge.

Mushroom (edible fungus) biology, a new branch of mycology, is specialized in the discussion of mushroom morphology, function, genetics, evolution, ontogeny, exploitation and its basic relations with the environment. Mushroom biology differs from mushroom science. Mushroom science is a branch of mushroom biology, as it mainly involves the mushroom cultivation, its production principles and practice. Mushroom biotechnology is a part of mushroom science and mainly involves mushroom products produced by fermentation or extraction. Although these discussion topics do not change, the methods of studying change with each passing day as natural science develops. As a result, the contents in textbooks on mushroom biology, research topics and methods are frequently added, deleted or updated. The collection of *Chinese Fungal Resources and Exploitation* having been compiled on the foundation of science, technology and research represents the most recent compendium of mushroom biology (macrofungi) in China. Many have underestimated the policies and results of science, technology and creation (STC) of edible fungi in China. Statistics shows that the power of investment in mushroom research, development and exploitation is substantial, which will inject energy into the continuous expansion of basic research and industrial development of edible fungi.

A clear-cut explanation on the definition of edible fungus (mushroom-macrofungus) has been given by the author in his preface. The term “edible mushrooms” or “medicinal mushrooms” is used in most international conferences and articles related to macrofungi, while edible fungi or medicinal fungi is rarely used.

It has been estimated recently that there are approximately three million fungal species on earth (Hawksworth DL, 2012. *Biodivers Conserv* 21:2425–2433; Wasser S P, 2014. *Biomed. J. Sci.* 37:345356), among which, about 100 thousand true fungal species have been denominated in 2012. However, new species continued to be discovered. In the past 10 years, around 60% of the new species of fungi were found in tropical climates. Up to now, it is estimated that there are 150~160 thousand mushrooms on earth, with approximately 16,000—only 10% of that are known. Among these, about 2000 are considered safe and edible, including over 700 mushrooms that have medicinal values. The biodiversity of mushrooms is a comprehensive biological science, which is of great importance for the investigation, identification and exploitation of new mushroom species in the future. The many issues that surround biodiversity are highly complicated. For example, how to build up protection policies including an understanding of the interaction between genetics and taxonomy, and how to explore new edible and medicinal mushroom resources from different levels. Therefore, it is absolutely critical to protect and genetically conserve pure wild species germ plasm.

Despite the fact that modern technology is playing a more and more important role in human civilization, the well-being of today's man is still confronted with three great challenges: regional food shortages, the decline in health quality as well as the deterioration of the ecological environment, which will become more and more serious as the population continues to grow worldwide. We hunger for the use of fair and effective global knowledge and technology to solve or alleviate these three challenges, especially the occurrence of harm to human health, which is not limited to poverty-stricken countries or a poverty-stricken class of a society. As a matter of fact, people living in well-educated and wealthy families in both developing and developed countries have many health problems as well, such as high blood pressure, heart disease and cancer—the so-called affluenza. These health problems bring unhealthy economic results, increase the living cost for both consumers and taxpayers, weaken labour capacity, which then becomes the main reason for low productivity.

Neither an individual nor a country can ignore this issue. I believe deeply that mushrooms can make great contribution to the three great challenges human beings face. Having been engaged in mushroom education and research for over 50 years, I have had opportunities to spread knowledge about mushroom biology, its research standards and utilization across five continents. Mushrooms are not only able to convert biological wastes containing copious cellulose and lignin into food, but also produce medically and nutritionally valuable products of great significance to human health. The most remarkable advantage of mushroom cultivation is, that once managed properly, it will alleviate the deterioration of the ecological environment, and probably even bring pollution of the environment to zero. Meanwhile, the formation of a foundation and subsequent development of mushroom industry offers new employment opportunities. Furthermore, cultivating and developing edible and medicinal mushrooms can create positive economic growth and have positive influence on individuals, regions and economic growth of countries. Therefore, mushroom research and development will continue to expand in the future. Since mushrooms produce (the mushroom itself), mushroom products (mushroom derivatives) and mushroom protection (utilization of waste) will contribute to the three challenges human beings face, sustainable research and development of mushroom research and exploitation can become a “none-green organisms” (as edible fungi are none-green organisms that do not contain chlorophyll).

In general, Professor Yu Li, the editor-in-chief, has taken great efforts in this collection from its conception to implementation. Authors of this collection are all extremely experienced in mushroom education and research. This is a set of magnum opus that comprehensively, completely and systematically introduces theory on mushroom resources, taxonomy, production and processing in China, a valuable masterwork on mushroom science.

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S. T. Chang

Preface

After 3 years of effort, *Atlas of Chinese Macrofungal Resources*, the first volume of *Chinese Fungal Resources and Exploitation* has been completed. Upon sending to press, here are a few words from my heart to the readers.

Fungal groups covered in this book are the large species mainly composed of mushrooms. Mushroom is also called gujun (Chinese) or macrofungus, so as to be distinguished from other microfungi such as mould and yeast. Chinese ancient texts named macrofungi grown on wood as Xun, and those in soil Jun, as commonly called mogu. In fact, originally the Chinese character “菌” (pronounced as jun) specifically refers to this type of fungi, an equivalent to the English word “mushroom”, German “Pilze”, French “champignon”, Russian “г р и б ы” and Japanese “キノコ”. As documented in *Origin of Chinese Characters (Shuo Wen Jie Zi)*, first Chinese dictionary, compiled by Xu Shen, 121 AD), the Character “菌” indicates that it is a life being that is of a plant nature, with a shape of a round granary. There are over 30 life beings of this type recorded in ancient Chinese documentations. The common name “蘑菇” (mushroom) only started to be used since the Yuan Dynasty. The definition of such life being by *DICTIONARY OF FUNGI* is: “a macrofungus with a distinctive fruiting body which can be either hypogeous or epigeous, large enough to be seen with the naked eye and to be picked by hand”, which refer to *Cordyceps* spp., *Morchella* spp., *Peziza* spp., *Tuber* spp.(truffle) of Ascomycetes; agarics, puffballs, boletes, coral fungi, Lingzhi and jelly fungi of Basidiomycetes. On the other hand, fungi like larger pathogenic fungi and myxomycetes can both “be seen with the naked eye and to be picked” (large enough), and there is no lack of atlas of macrofungi in the world that includes them.

To make this book a good one, authors had to consider these questions:

First, Why This Kind of Book?

There are a lot of records on fungi in vast ancient Chinese documentations, and a systematic atlas started in the Northern and Southern Dynasties (420–589), with no less than a thousand publications until today. Especially in the past 10 years, new books started mushrooming, brought forward by the press of different regions and types. The value of spreading science by way of these books is tremendous, not to mention the great efforts by the authors. They have made fungal biology previously overlooked more and more interesting. Nevertheless, among existing publications of the like because of the scientific knowledge of the time when published and the authors’ level of expertise, inaccurate documentation can often be seen. As the science and technology advance and the Chinese national power strengthens, the people of the country have become leaders in this field of study. While great number of new species are discovered, many identification errors in the past have been corrected, and recognition of the vast fungal resources in China has been refreshed. Therefore, authors and many peers realized the necessity to publish an atlas of macrofungi that represents the contemporary research level in China, that is on a par with internationally excellent work, and that can comprehensively and scientifically portray resources in China based on the accumulation of research results in the past 10 years (especially nearer years) and provide tools to correctly identify the macrofungal

resources in China. Without the right tools, people might be doing work in a less efficient way, somewhat like watering the garden by carrying a huge jar as Chinese said in the past, resulting in mistakes that might pass on even to our children. Therefore, the publication of this book is the call of the era and the need of the industry, as well as the expectation of our peers.

Second, What Kind of Book?

Books on mushrooms around the world, from monographs on different taxa to popular science readings, are numerous and even too many to catalogue. Monotonous are the books of the like in China in content, structure and layout, with some having identical contents, excerpts and even copies from others, but few are stunning. When writing this atlas, the authors had taken into account the following hypothetical scenario: should it become a voluminous work on taxonomy, then only a few readers would be able to understand or appreciate it; on the other hand, should it become entry-level book, it is easy to get stuck in a rut and lack new ideas. Therefore, authors strived for a breakthrough on contents, materials, layout and editing to make both pictures and text excellent, scientifically accurate, easy to understand, elegant and vivid. “Admired by scholars and laymen alike, welcomed by most readers, used in wide” and “popular but not vulgar” were the common views and the target to pursue by authors.

Third, What Style?

How can this book serve both as references to a scientist and entry level readings to young people, while enjoyed by many? Neither obscure scientific terminologies nor systematic arrangement style of a taxonomist would work. Therefore, when introducing fungal varieties, images and texts were not arranged strictly following the arrangement scheme popularly adopted by the modern taxonomy system, but starting with morphology as the main recognition characteristics, and then divided into ten big groups. Varieties in the same group were arranged by alphabetic order of their Latin names for easy reference; generic name of one variety that matches recent taxonomic research results or molecular biology evidence is used when assigning it to a generic group. The systematic relations of all macrofungi of each genus are sufficiently illustrated in Chap. 1, Overview. This way, it is not only convenient and straightforward, but also reflects the connotations of modern scientific results.

Relevant knowledge is manifested in overview and glossaries. All is made easy to start, grasp, understand and use, which brings a vividness to this academic book of knowledge, without becoming serious and monotonous.

Fourth, How to Demonstrate the Scientific Value of This Book?

Scientific value is undoubtedly the soul of all scientific writings, but science is a progressive knowledge system. As the level of knowledge advances, scientific methods improve, and knowledge of the interrelation among things gets deeper, therefore the continual correction of mistakes becomes inexorable. On a certain space-time coordinate point, relative accuracy is the embodiment of scientific value. This is the realm the authors pursue. Therefore, to be factual and scientific, geographic zones of macrofungal resources defined in this book have been amended according to geographic and natural ecologic environmental factors based on the research of our predecessors, rather than some administrative division. What is used are the most recent research results based on the vegetation classification in China in the regionalization system in this book, combined with specimen collection records in the past, and regional distribution consideration is given to relevant species. Hopefully this new attempt will present the fungal resource characteristics in all locations within China and their relationship with

natural climate, geography, habitat and ecology in a more reasonable, scientific and factual manner. Similarly, descriptions and images in this book are based on the confirmed results of specimens studied, compared with those of the same types or groups both home and abroad and then identified by authors, strictly following taxonomical principles. None have been selected by resemblance. Assumption based on uncertain information or identification by pictures was ruled out. During compilation of this book, the following principles were adhered to: candidates with uncertainty out; pictures, specimens and description that are not consistent or do not corroborate each other out; images unclear, unreal or imprecise out. Even if affiliation of any changes in the future, the specimens and evidence still remain. Authoritativeness is manifested through scientific value, with only truth is talked about, which reflect the saying “practice is the sole criterion of truth”.

Fifth, How to Reflect the Representative Value of This Book?

As an atlas covering the main ecological regions across the country, its extent and representative value are consistent. Generally speaking, only things coming from China can represent China; the more taxa come from a country, the better they demonstrate the characteristics of that country; only by including more taxa can each biological taxon be better represented; only experts who have studied and recognized many species of certain taxon and gone deeper into their biology can better represent the knowledge level of that taxon. To sufficiently bring forward the representation, more than 1,800 species (variants) of fungi were selected from millions of specimens collected from different ecological regions of China to be included in this book, making it an atlas of macrofungi that includes the most numerous varieties, denominated by Chinese scholars, and most numerous species discovered with authors' personal involvement of the like in China until today. Since China has abundant and diverse fungal resources, with many extremely similar to those abroad, unexpected difficulties always exist when identifying a specimen accurately. A great number of specimens are either questionable or lack of reliable proof. Some specimens are unavailable though they have been recorded. Such paucity, regrettably, will have to be passed on to future generations. Fortunately, the four main co-authors have been working closely with me and made great contributions to the scientific value and representative value of the atlas. All of them are frontline scientists, young and full of energy, who have intact education or research experience in both home and/or abroad, and who have done research in depth in each of their own fields. During the compilation of this book, the portions they each undertook were fields particularly familiar to them, and who represent the current cognitive level of relevant macrofungal resources in China. Great support and assistance were offered by experts from different subfields throughout the country, resulting in a greater representative value of this atlas.

Sixth, How to Present the Originality of This Book?

The lure of originality is irresistible to scientists who are not willing to be outdone, and so it is expected by the readers. The originality of a book is vital. Therefore, it was the objective of the authors devoted in their own field for many years to maintain originality and respect for the reader, by including pictures and specimens of fungal taxa which had been verified repeatedly. This is the presentation of their academic achievements accumulated from long-term research efforts. Quality was put before quantity while selecting materials, with solid proof accompanied and requiring that each must be clear, accurate and honest. Confusion, unconformity or poor quality were not tolerated. All of the images and pictures came from China, and all descriptions were made based on Chinese specimens (including hundreds of type specimens that the authors of this book used when publishing new species) and pictures, of which quite a number are endemic species and newly recorded species through many years of research by

authors. None was borrowed from overseas, none thrown in to make up the number or plagiarized! The result is to guarantee the originality and truthfulness of their work.

Seventh, How to Present the Contemporary Value of This Book?

Species, relatively stable, independent to a changing life system are the most basic units for the understanding of the world of life through science, and which is formed through reproductive and geographic isolation throughout the long-term evolutionary process. Innumerable biologists are fascinated by the mystery of biological diversity. The accumulation of knowledge by generations of taxonomists has created a valuable resource. On top of it, the development and application of modern molecular biology has continued to improve people's knowledge of the species concept. The newest discoveries of science have made the evergreen tree of life sparkle brightly. For historical reasons and for those that we all know, in the past 200 years, China's domestic scientific research on her resources has fallen behind that of Japan and the Western world. Even today, quite a few areas of research lag and must refer to, imitate or even borrow data from beyond China. China's knowledge of its own fungal resource is no exception. Due to all limitations from the past, a lack of knowledge about species as denominated by the West made it difficult to compare them with specimens of our own, therefore resulting in the inability to conduct research on our own specimens in depth, hence a creating significant existing confusion of names. Many of China's species have been mistakenly identified as species reported by developed countries in Europe and America for a long period of time, causing tremendous confusion to science, production and daily life. In fact, the differences are great between biological taxa in the east and the west by nature. Here is one case. Lingzhi, highly valued in China for thousands of years, and still popular and beloved today, has long been titled *Ganoderma lucidum*, a name from Europe. Indeed, the commonly cultivated Lingzhi in China is anything but *Ganoderma lucidum* commonly seen in Europe; neither is the widely cultivated black wood-ear in China the same species as the European *Auricularia auricula-judae*! Let alone Xiuqiuju, the "rising star" of today, is absolutely not the *Sparassis crispa* in Korea and Japan but *S. latifolia*. Many are the cases like these. Since the reforming and opening of China, the authors have discovered a large number of new fungal species and new resources in each of their respective field of specialty and have corrected many mistakes made in identification. This atlas, to a great extent has summarized the research results of the recent decades in China, bringing forth the most recent research results in a contemporary way. For example, species introduced in this book that have been published after the year 2000 alone are as many as 380—all showing an impress of the new epoch.

Finally, How to Present the Artistry of This Book?

A good book that becomes a must-have for scientific and technological workers, a book that readers hate to put down, in addition to its novelty, richness and splendidence, the artistry is of great importance. The quality of editing, layout, paper, binding and printing are important factors, none of which can be poor or absent. The saying "fine feathers make fine birds" explains it all. Of course, "fine feather" should not eventually become the apple of Sodom. Editing and publishing, a profession of its own, can completely affect the level of a publication's quality both inside and outside. Publications of similar type, in comparison, can vary in quality. In terms of being exquisite, publications in Japan and Germany enjoy a good reputation. How to make this book equivalent to those is a severe test to the publisher. With colour printing equipment standardized in quality today, factors such as layout, paper and printing represent the vision, level and handling of a publisher to a greater degree. I am very grateful to the director, editor-in-chief and their colleagues of Central China Farmer's Publishing House for the great effort they put into this project. Despite their history of producing multiple splendid presenta-

tions, once again they strived for perfection, and even went off the beaten track, to achieve more visual impact and aesthetic effect in the layout: a combination of science and art, a presentation of culture and beauty! I believe compliments naturally burst forth when readers are presented with this new book, while a delicate smell of printing oil is still given off. We also believe that time will confirm the scientific and artistic value of this book.

Besides the hard work by the authors of this book, generous contributions were offered by some renowned research organizations and scholars from both home and abroad, their supply of data, specimens and pictures—icing on the cake. My gratitude goes to them all!

Nowadays, many in academia no longer bother to recognize life forms at morphological level! Not to mention field trips! Hot is the game of four base-pairs! Nothing is wrong with doing research using new technology itself since through history it is inevitable that traditional science continues to fuse itself with new technology. But favouring one over another, or even abandoning the fundamentals, is just like the blind men trying to size up the elephant-taking a part for the whole and building a tower upon sand. Such research behaviour is a misguidance to future generations! By surrendering to SCI impact factors, many go after fame and gain, like flies after a stink, vying for the higher, while becoming flighty and impetuous. What a vanity fair! Can we call it Sodom and Gomorrah of academia? Who is able to save it then? Fortunately, some unreconciled intellects stay sober, sane and simple, with an attitude of “seek root, leave flower to others”. They care only for concrete matters, spending most of their time in the field, where the main battlefield of economy remains—a ray of hope.

“I oft regret spring’s gone without leaving its trace; I do not know it’s come up to adorn this place”. This Chinese ancient poem keeps reminding us that hope is always around. After dozens of years of travelling over mountains and rivers, exposed to cold and wet, looking through every tree and bush for a trace of mushroom, researchers have been able to present these lovely beings, with freshest looking view: many littles make a mickle. Publication can mean an Omega, but it can also mean another Alpha to newer, higher and finer chapter yet to come! Young mycologists, play not the old music, but compose your own!

Neither do we have the intention nor the nerve to claim that this book is perfectly accurate, but we did our utmost to bring errors to a minimum level. We expect it to be the new starting point for the mycological resource research in China. A long journey can be covered only by taking one step at a time, and an ocean can be made only by saving every drop of water. Mycologists, bear this in mind and start from within yourself now, or you will not be able to make steady progress and innovation like the waves behind driving on those before.

Move on and we look forward to your great achievements!

With compliments,

Changchun, China
Winter of 2014

Yu Li

User's Guide

Structure

1. Overall structure

The overall structure is composed of forewords, preface, table of contents, overview, colour photographs and descriptions of all species of the macrofungi, glossaries, references, indices of Chinese and Latin scientific names, afterword and acknowledgement.

2. Overall chapters

Overview, colour photographs and characterization of every species of the macrofungi make up the main body of this book. The 1800 plus macrofungi are divided into ten groups and introduced in 10 chapters each according to their taxonomic and morphological characteristics.

3. Introduction of species

Beginning with Chap. 2, the introduction to each species typically includes at least one colour photograph in its natural environment, its Chinese name, some vernacular names, its Latin scientific name and some synonyms, its main macroscopic and microscopic structural characteristics, ecological habits, distribution and economic value, etc.

How to Search

Several methods have been provided for easy access to a specific species or group depending on the choice of the reader.

1. Search by Latin scientific name index (in alphabetic order)

The page number of text where certain species appears can be searched by the Latin scientific name index at the back of this book if known, through which further information on this species can be accessed. The same method applies if Latin synonyms are available.

2. Search by Chinese name index (in Chinese pinyin's alphabetic order)

The page number of text where certain species appears can be found by the Chinese name index at the back of this book if known, through which further information on this species can be accessed. The same method applies if Chinese vernacular names are available.

3. Search by table of contents

All species belonging to different groups are arranged in alphabetic order by their Latin scientific names. If the Latin scientific name of a certain species and to which of the ten groups it belongs is known, the page number of text where this species appears can be accessed by looking up table of contents of this group. For example, when searching for the page number of text where *Agaricus bisporus* under the group of *Agarics* appears, by looking up to "Chapter VII AGARICS" in table of contents, one can find that the page number of text where *Agaricus bisporus* appears is 682.

4. Search by colour blocks in specific parts on side cut and bottom cut

Different colour blocks are printed above even page numbers in the lower left corner and to the left of the odd numbers in the lower right corner in this book to make distinguishing different chapters easy. is for overview, is for the larger ascomycetes, is for the jelly fungi, is for the coral fungi, is for the polyporoid, hydneous, and thelephoroid fungi, is for the cantharelloid fungi, is for the agarics, is for the boletes, is for the gasteroid fungi, is for the large pathogenic fungi on crops, is for the large myxomycetes, is the glossaries, is the indices, and is for the reference.

On Partial Formats and Contents

1. Names of fungi

Normative names of each fungus are given in the detailed introduction on different varieties of macrofungi from Chaps. 2–11, including scientific names in Chinese and Latin. Frequently used Chinese vernacular names will be listed in brackets after each fungus' normative Chinese name if available; frequently used and important Latin synonyms will be listed under the fungus' scientific name if available.

2. Norms of scientific names

Norms used for scientific names in this book is mainly based on *International code of Nomenclature for algae, fungi, and plants*, cross-checked with *Index Fungorum*, *Dictionary of Fungi 10th Edition*, literature where the scientific name first appeared, textual research papers on scientific names and the most recently published literature on mycological taxonomy. This includes the principle that the norms for authors (nomenclators) must comply with the regulations, for example, abbreviation of nomenclator contained in a scientific name must comply with regulations of *Authors of Fungal Names* and *Authors of Plant Names*.

3. Omission of nomenclator

When the number of authors (nomenclators) of a scientific name is 1~2, all names will be listed, for example, both nomenclators “Zhu L. Yang & T. H. Li” in *Amanita exitialis* Zhu L. Yang and T. H. Li are listed; when the number is 3 or above, only the name of the first nomenclator is listed and the ones behind will be replaced with “et al.”, for example, there are three nomenclators, “W.Q. Deng, T.H. Li & Zhu L. Yang”, for *Amanita macrocarpa* W.Q. Deng et al. indeed, but it is shown in this book as “W. Q. Deng et al.”

4. Simplification and abbreviation of scientific names

To save space, except for the purpose of giving an introduction on a specific fungal species itself, only names of the genus and specific epithet is listed while all nomenclators are omitted for the scientific name of a fungus listed for discussion or example illustration; the generic name is given in full when it first appears in a chapter, but will be abbreviated (i.e., the first letter of the generic name is capitalized with a foot a dot) when it appears again, then followed by specific epithet and so on.

5. Size of fungus in image

For the purpose of typography and reading, the size of images of fungi is neither reduced nor enlarged to a consistent scale according to their actual size. Description on a fungus should be referred to for its actual size only.

6. Order of images

For easy access to main fungi in this book, image order in Chapter I Overview is arranged separately; serial number of each species is consistent with that of its description from Chaps. 2–11.

7. Order of references

References in Chinese and foreign languages are listed separately. References in Chinese are arranged in pinyin alphabetical order and those in foreign language in English alphabetic order.

8. Morphologic characteristics

Morphologic characteristics are presented by both colour images and text descriptions. Macroscopic characteristics of a fungus by text description include size, shape, colour (and discolouration because of a bruise) and appendant of its main parts. Microscopic characteristics include size, shape and surface features. Major changes to colour and size of a fungus might occur because of the impacts of its ecologic environment, weather and maturity, which may not be entirely covered by images or text description. Some characteristics in common with or similar to fungi of the same type are usually omitted in text descriptions.

9. Distribution

Distribution area of macrofungi in China is divided into seven major regions in this book: Northeast, Northern, Central China, Southern China, Inner Mongolia, Northwest and Qinghai-Tibet Region. Introduction on each species contains its distribution information in other regions. Some reports on the distribution of certain species were made on the basis of mistakenly identified specimens or even without availability of a voucher specimen. Although a small number of species have been reported in certain regions of China because the authors of this book were not able to find solid and reliable confirmation, distribution of these species has not been included in this book. Therefore, known distribution range listed in this book may seem narrower than that introduced in other literature.

10. Economic values

Brief introduction on known edible, medicinal and economic values of different species is provided in this book; no notation is given to the species with unclear economic values.

11. Conventional expressions

Conventional expression accepted and commonly used by international mycological colleagues for size and measurements of macrofungi's microscopic structure is adopted by this book, i.e. the number before “×” indicates the length of the structure and width behind, with length unit appearing only once at the end. For example, when indicating the length of a spore as 9~10 μm and width 4~5 μm, the form “spore 9~10 × 4~5 μm” is used for description, rather than the form “(9~10) g × (4~5) g” as required by national standards. This is to be in unity with the international mycological circle and easier for exchanges among colleagues. In addition, some conventional expressions in this book, for example, “pip-shaped” means the shape of apple or pear seeds, rather than shapes of other seeds; “pinkish” means the skin colour of a regular white person or a yellow person with pinkish colour. These notes are for the correct understanding.

Mushrooms and toadstools and other larger fungi have become increasingly popular in recent years. They are not only of fascinating scientific interest but are extremely beautiful and variable in their form, offering pleasure to both artist and photographer. Their “overnight” appearance has made them objects of mystery and folklore for centuries. In addition, many species are edible and delicious, so providing a ready source of food and enriching many culinary dishes.

D. N. Pegler

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Sincere thanks to all the friends who helped in the preparation and publication of this book!

Brief Introduction

One thousand eight hundred and nineteen species (or varieties) in 509 genera of macrofungi known from China are documented in this work. According to their morphological characteristics, they are practically divided into 10 groups and introduced in 10 chapters accordingly, including 196 larger ascomycetes, 21 jelly fungi, 47 coral fungi, 637 polyporoid, hydneous and thelephoroid fungi, 11 cantharelloid fungi, 653 agarics, 130 boletes, 75 gasteroid fungi, 16 larger pathogenic fungi on crops and 33 larger myxomycetes. All species are evidenced with vouchers and photographs. About 370 species (occupying 1/5 of the total species) with type localities in China are included, among which over 260 species (accounting for 1/7 of the species) were firstly discovered and published by the present authors, some of them as specific species in China and East Asia, which have tried to present the latest knowledge about the Chinese macrofungal resources.

All species are described accompanied with colour photographs showing their macro-morphology and (or) habitat. The macroscopic and microscopic diagnostic characters, ecological habits, economic importance (edibility, medicinal availability or toxicity) and geographical range in China are provided. The characteristics and using method of the book, related mycological vocabulary, common taxonomic techniques and positions of the fungal genera in modern taxonomic system are briefly introduced. For the convenience of the readers, all species in the ten chapters are arranged in alphabetical order of their Latin names, and indices of Chinese names and scientific Latin names to all species are appended.

The knowledge of this book should be interesting for mycologists, mycology fans and mushroom lovers, as well as for researchers, teachers and students studying on edible fungi, plant pathology, healthcare and biomedicine sciences, bioresources and biodiversity, ecology and other related disciplines. It is an ideal reference for those who are interested in the Chinese macrofungi and larger slime molds.

Foreword to the English Version of the Atlas

In the last century, the understanding and research level of macrofungal resources in China lagged far behind that of developed countries in Europe and North America. Not only was the number of known species fairly limited, but misidentification was rather common, with quite a few species endemic to China or Asia being misidentified as those already described in Europe, America, or elsewhere. There were only a few published atlases of Chinese macrofungi at that time.

Since the beginning of this century, China has rapidly developed in the field of mycology and has gradually become the most active country globally in mycological research, with the highest number of new species discovered each year. The *Atlas of Chinese Macrofungal Resources* was compiled by several of China's most active research teams on macrofungal resources, showcasing numerous discoveries in this century. The Chinese version of the atlas was published by Central China Farmers Publishing House in 2015.

Compared with the previous macrofungal atlases in China, the *Atlas of Chinese Macrofungal Resources* contains the most species, including 1819 species of 509 genera. Among them, more than 330 new species were discovered in this century, reflecting the latest research results. Over 370 species originally described from China were included, better reflecting the characteristics of China's macrofungal resources, with more than 260 species jointly discovered by the five lead authors and their collaborators. Since its publication, the atlas has been warmly welcomed by the majority of readers, affirmed by domestic mycologists and other readers, and has also attracted high attention from overseas enthusiasts.

However, being an atlas compiled in Chinese poses a challenge for most foreign readers who do not understand the language. Therefore, Springer Publishing House, Central China Farmers Publishing House, and the main authors of the Atlas reached a consensus to translate the Chinese content into English for publication, enabling more foreign readers to comprehend the content.

More than 8 years have passed since the atlas was first published. During this period, research on macrofungal resources in China has accelerated, with a continuous discovery of more new species. Upon comparison with recent research results, it was found that some pictures in the atlas represent new species published in recent years after its initial release.

As a translated work, maintaining consistency with the original content is crucial. For species requiring name changes in light of recent research progress, the original names are retained. However, the main authors of the atlas and the translators also seek to use the opportunity of publishing the English version of the atlas to inform readers of the name changes for these fungi, providing more insight into recent research progress in China. The names of the species that should be changed are listed in the following tables, with the hope that it will aid readers in understanding these fungal species more accurately.

The task of determining whether the species names in the atlas should be changed is highly professional and time-consuming. To accomplish this, in addition to several main authors of the original work, many younger mycologists participated. They are (in alphabetical order by name): Qing CAI, Baokai CUI, Yuguang FAN, Guojie LI, Jipeng LI, Ting LI, Junfeng LIANG, Chaoqun WANG, Xianghua WANG, Yuanbing WANG, Fang WU, Gang WU, Niankai ZENG,

Ming ZHANG, Ping ZHANG, Ruilin ZHAO, Changlin ZHAO, et al. The authors and translators express their heartfelt thanks to them.

The leaders and editors of Springer Publishing House and Central China Farmers Publishing House have provided the necessary publishing funds and contributed significantly to the publication of the English version of the atlas. The authors and translators express their sincere gratitude for their enthusiastic support and assistance in various aspects.

Due to the limited knowledge and English proficiency of the translators, and considering the extensive nature of the translation content, errors and omissions are inevitable. The translators hope for the readers' understanding and assistance in addressing any shortcomings.

Translators, October 2023

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

—Changes in Larger Ascomycetes

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Cordyceps gunnii</i> (Berk.) Berk.	<i>Keithomyces neogunnii</i> (T.C. Wen & K.D. Hyde) Luangsa-ard et al.	2020
<i>Cudonia</i> sp. 1	<i>Cudonia claviformis</i> Zhu L. Yang	2023
<i>Cudonia</i> sp. 2	<i>Cudonia furfuracea</i> Zhu L. Yang	2023
<i>Isaria cicadae</i> Miq.	<i>Cordyceps chanhua</i> Z.Z. Li et al. 2021	2021

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

—Changes in Jelly Fungi

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Auricularia delicata</i> (Mont.) Henn.	<i>Auricularia sinodelicata</i> Y.C. Dai & F. Wu	2021
<i>Auricularia mesenterica</i> (Dicks.) Pers.	<i>Auricularia asiatica</i> Bandara & K.D. Hyde	2016
<i>Exidia recisa</i> (Ditmar) Fr.	<i>Exidia yadongensis</i> F. Wu et al.	2020
<i>Tremella foliacea</i> Pers.	<i>Phaeotremella yunnanensis</i> L.F. Fan et al.	2020

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

—Changes in Coral Fungi

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Ramaria broomei</i> (Cotton & Wakef.) R.H. Petersen	<i>Phaeoclavulina macrospora</i> Brinkmann	1897

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

—Changes in Polyporoid, Hydnnaceous & Thelephoroid Fungi

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Antrodia albida</i> (Fr.) Donk.	<i>Antrodia heteromorpha</i> (Fr.) Donk	1966
<i>Antrodia carbonica</i> (Overh.) Ryvarden & Gilb.	<i>Lentoporia subcarbonica</i> B.K. Cui et al.	2022
<i>Antrodia hingganensis</i> Y.C. Dai & Penttilä	<i>Adustoporia sinuosa</i> (Fr.) Audet	2017

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Antrodia huangshanensis</i> Y.C. Dai & B.K. Cui	<i>Cartilosoma ramentaceum</i> (Berk. & Broome) Teixeira	1986
<i>Antrodia macrospora</i> Bernicchia & De Dominicis	<i>Dentiporus albidoides</i> (A. David & Dequatre) Audet	2017
<i>Antrodia wangii</i> Y.C. Dai & H.S. Yuan	<i>Fomitopsis bondartsevae</i> (Spirin) A.M.S. Soares & Gibertoni	2017
<i>Auriscalpium vulgare</i> Gray	<i>Auriscalpium microsporum</i> P.M. Wang & Zhu L. Yang (The fruiting bodies in the small round picture)	2019
<i>Fomitopsis feei</i> (Fr.) Kreisel	<i>Rhodofomes roseus</i> (Alb. & Schwein.) Kotl. & Pouzar	1990
<i>Fomitopsis pinicola</i> (Sw.) P. Karst.	<i>Fomitopsis subpinicola</i> B.K. Cui et al.	2021
<i>Fomitopsis spraguei</i> (Berk. & M.A. Curtis) Gilb. & Ryvarden	<i>Niveoporofomes orientalis</i> B.K. Cui & Shun Liu	2023
<i>Hyphodontia radula</i> (Pers.) Langer & Vesterh.	<i>Xylodon raduloides</i> Riebesehl & Langer	2017
<i>Parmastomyces mollissimus</i> (Maire) Pouzar	<i>Sarcoporia polyspora</i> P. Karst.	1894
<i>Serpula similis</i> (Berk. & Broome) Ginns	<i>Serpula dendrocalami</i> C.L. Zhao	2019

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

——Changes in Cantharelloid Fungi

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Cantharellus cibarius</i> Fr.	<i>Cantharellus applanatus</i> D. Kumari et al.	2013
<i>Cantharellus minor</i> Peck	<i>Cantharellus elongatipes</i> D. Kumari et al.	2013
<i>Cantharellus tuberculosporus</i> M. Zang	<i>Cantharellus versicolor</i> S.C. Shao & P.G. Liu	2016
<i>Gomphus floccosus</i> (Schwein.) Singer	<i>Turbinellus szechwanensis</i> (R.H. Petersen) Xue Ping Fan & Zhu L. Yang	2023
<i>Gomphus fujishanensis</i> (S. Imai) Parmasto	<i>Turbinellus parvisporus</i> Xue-Ping Fan & Zhu L. Yang	2023

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

——Changes in Agarics

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Agaricus radicatus</i> Schumach.	<i>Agaricus beijingensis</i> R.L. Zhao et al.	2021
<i>Agaricus subrufescens</i> Peck	Uncertain species of <i>Agaricus</i> sp.	—
<i>Amanita hemibapha</i> (Berk. & Broome) Sacc. s.l.	<i>Amanita rubroflava</i> Y.Y. Cui et al.	2018
<i>Amanita manginiana</i> Har. & Pat.	<i>Amanita caojizong</i> Zhu L. Yang et al.	2018
<i>Crepidotus badiofloccosus</i> S. Imai	<i>Crepidotus crocophyllus</i> (Berk.) Sacc.	1887
<i>Crepidotus cinnabarinus</i> Peck	<i>Crepidotus reticulatus</i> T. Bau & Y.P. Ge	2020
<i>Gymnopus polyphyllus</i> (Peck) Halling	<i>Gymnopus sinopolyphyllus</i> J.P. Li et al.	2022
<i>Hygrocybe cuspidata</i> (Peck) Murrill	<i>Hygrocybe rimosa</i> C.Q. Wang & T.H. Li	2021

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Hygrocybe</i> cf. <i>nigrescens</i> (Quél.) Kühner	<i>Hygrocybe rubroconica</i> C.Q. Wang & T.H. Li	2020
<i>Hygrophorus cossus</i> (Sowerby) Fr.	<i>Hygrophorus glutiniceps</i> C.Q. Wang & T.H. Li	2019
<i>Lactarius camphoratus</i> (Bull.) Fr.	<i>Lactarius rufus</i> (Scop.) Fr.	1838
<i>Lactifluus hygrophoroides</i> (Berk. & M.A. Curtis) Kuntz	<i>Lactifluus pseudohygrophoroides</i> H. Lee & Y.W. Lim	2017
<i>Lactifluus subvellerus</i> (Peck) Nuytinck	<i>Lactifluus pilosus</i> (Verbeken et al.) Verbeken	2011
<i>Mycena capillaripes</i> Peck	Uncertain species of <i>Mycena</i> sp.	—
<i>Mycena galericulata</i> (Scop.) Gray	<i>Mycena maculata</i> P. Karst.	1890
<i>Mycena metata</i> (Fr.) P. Kumm.	Uncertain species of <i>Marasmius</i> sp. or <i>Gymnopus</i> sp.	—
<i>Mycena polygramma</i> (Bull.) Gray	Uncertain species of <i>Mycena</i> sp.	—
<i>Mycena sanguinolenta</i> (Alb. & Schwein.) P. Kumm.	<i>Mycena haematopus</i> (Pers.) P. Kumm.	1871
<i>Psathyrella gracilis</i> (Fr.) Quél.	<i>Candolleomyces candolleanus</i> (Fr.) D. Wächt. & A. Melzer	2020
<i>Psathyrella kauffmanii</i> A.H. Sm.	<i>Psathyrella spintrigeroides</i> P.D. Orton	1960
<i>Psathyrella multissima</i> (S. Imai) Hongo	<i>Psathyrella boreifasciculata</i> Kytöv. & Liimat.	2014
<i>Psathyrella olympiana</i> A.H. Sm.	<i>Candolleomyces subminutisporus</i> T. Bau & J.Q. Yan	2021
<i>Psathyrella spadiceogrisea</i> (Schaeff.) Maire	<i>Candolleomyces subcacao</i> T. Bau & J.Q. Yan	2021
<i>Psathyrella spintrigeroides</i> P.D. Orton	<i>Psathyrella plegophila</i> Romagn.	1985
<i>Russula</i> cf. <i>amoena</i> Quél.	<i>Russula pseudoamoenicolor</i> A. Ghosh et al.	2016
<i>Russula japonica</i> Hongo	<i>Russula brevispora</i> Y.L. Chen & J.F. Liang	2023
<i>Squamanita umbonata</i> (Sumst.) Bas	<i>Squamanita sororcula</i> J. W. Liu & Zhu L. Yang	2021
<i>Strobilurus</i> sp.	<i>Strobilurus orientalis</i> Zhu L. Yang & J. Qin	2018
<i>Tricholoma pardinum</i> (Pers.) Quél.	<i>Tricholoma sinopardinum</i> Zhu L. Yang et al.	2017

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

—Changes in Boletus

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Boletellus chrysenteroides</i> (Snell) Snell	<i>Boletellus putuoensis</i> N.K. Zeng et al.	2022
<i>Boletellus emodensis</i> (Berk.) Singer	<i>Boletellus areolatus</i> Hirot. Sato	2015
<i>Boletellus longicollis</i> (Ces.) Pegler & T.W.K. Young	<i>Aureoboletus viscosus</i> (C.S. Bi & Loh) G. Wu & Zhu L. Yang	2016
<i>Boletellus obscurcoccineus</i> (Höhn.) Singer	<i>Boletellus puniceus</i> (W.F. Chiu) X.H. Wang & P.G. Liu	2002
<i>Boletellus meruloides</i> (Schwein.) Murrill	<i>Psiloboletinus lariceti</i> (Singer) Singer	1945
<i>Boletus bicolor</i> Raddi	<i>Lanmaoa asiatica</i> G. Wu & Zhu L. Yang	2015
<i>Boletus hortonii</i> A.H. Sm. & Thiers	<i>Hemileccinum</i> cf. <i>rugosum</i> G. Wu & Zhu L. Yang	2016
<i>Boletus inedulis</i> (Murrill) Murrill	<i>Butyriboletus hainanensis</i> N.K. Zeng et al.	2016

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Boletus kermeinus</i> Har. Takah. et al.	<i>Butyriboletus ruber</i> (M. Zang) Kui Wu et al.	2020
<i>Boletus meiweiniuganjan</i> Dentinger	<i>Boletus bainiugan</i> Dentinger	2013
<i>Boletus nigropunctatus</i> W.F. Chiu	<i>Hourangia cheoi</i> (W.F. Chiu) Xue T. Zhu & Zhu L. Yang	2015
<i>Boletus paluster</i> Peck	Uncertain species of <i>Suillus</i> sp.	—
<i>Boletus quercinus</i> Hongo	<i>Caloboletus guanyui</i> N.K. Zeng et al.	2019
<i>Boletus subtomentosus</i> L.	<i>Xerocomus</i> cf. <i>rugosellus</i> (W.F. Chiu) F.L. Tai	1979
<i>Boletus subvelutipes</i> Peck	<i>Lanmaoa</i> cf. <i>angustispora</i> G. Wu & Zhu L. Yang	2015
<i>Boletus umbriniporus</i> Hongo	<i>Neoboletus</i> cf. <i>brunneissimus</i> (W.F. Chiu) Gelardi et al.	2014
<i>Gyroporus cyanescens</i> (Bull.) Quéf.	<i>Gyroporus alpinus</i> Yan C. Li et al.	2021
<i>Heimioporus retisporus</i> (Pat. & C.F. Baker) E. Horak	<i>Heimioporus gaojiaocong</i> N.K. Zeng & Zhu L. Yang [with a fruitbody of <i>Heimioporus japonicus</i> (Hongo) E. Horak at the last in the photo]	2018
<i>Mucilopilus castaneiceps</i> (Hongo) Hid. Takah.	<i>Mucilopilus paracastaneiceps</i> Yan C. Li & Zhu L. Yang	2021
<i>Pulveroboletus auriflammeus</i> (Berk. & M.A. Curtis) Singer	<i>Aureoboletus miniatoaurantiacus</i> (C.S. Bi & Loh) Ming Zhang et al.	2019
<i>Retiboletus griseus</i> (Frost) Manfr. Binder & Bresinsky	<i>Retiboletus fuscus</i> (Hongo) N.K. Zeng & Zhu L. Yang	2016
<i>Retiboletus nigerrimus</i> (R. Heim) Manfr. Binder & Bresinsky	<i>Retiboletus</i> cf. <i>zhangfeii</i> N.K. Zeng & Zhu L. Yang	2016
<i>Rubinoletus balloui</i> (Peck) Heinem. & Rammeloo	<i>Tylopilus rubrotinctus</i> Yan C. Li & Zhu L. Yang	2021
<i>Sinoboletus gelatinosus</i> M. Zang & R.H. Petersen	<i>Aureoboletus duplicatoporus</i> (M. Zang) G. Wu & Zhu L. Yang	2016
<i>Suillus bovinus</i> (L.) Roussel	<i>Suillus</i> cf. <i>pinetorum</i> (W.F. Chiu) H. Engel & Klofac	1996
<i>Xanthoconium</i> cf. <i>affine</i> (Peck) Singer	<i>Xanthoconium sinense</i> G. Wu et al.	2016
<i>Xerocomellus rubellus</i> (Krombh.) Šutara	<i>Hortiboletus subpaludosus</i> (W.F. Chiu) Xue T. Zhu & Zhu L. Yang	2016

Name Changes of Some Fungi in *Atlas of Chinese Macrofungal Resources* Mainly Since Publication

——Changes in Gasteroid Fungi

The species name in the 2015 Chinese edition of <i>Atlas of Chinese Macrofungal Resources</i>	The name of the fungi in the photo of the atlas which should be changed to	The publishing year of the changed name
<i>Dictyophora duplicata</i> (Bosc) E. Fisch.	<i>Phallus ultraduplicatus</i> X.D. Yu et al.	2015
<i>Dictyophora indusiata</i> (Vent.) Desv.	<i>Phallus rigidiindusiatus</i> T. Li et al.	2021
<i>Dictyophora multicolor</i> Berk. & Broome	<i>Phallus luteus</i> (Liou & L. Hwang) T. Kasuya	2009
<i>Phallus impudicus</i> L.	<i>Phallus dongsun</i> T.H. Li et al.	2020
<i>Phallus rubicundus</i> (Bosc) Fr.	<i>Phallus rugulosus</i> (E. Fisch.) Lloyd, Yu Li, Taihui Li, Zhuliang Yang, Tolgor Bau, & Yucheng Dai	1908