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Diversity of Wood-Decaying Fungi in Wuliangshan Area, Yunnan Province, P.R. China

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Abstract: Five surveys were carried out in the Wuliangshan area, Yunnan Province, P.R. China, based on a combination of morphological features and molecular evidence. Around 2454 specimens of wood-decaying fungi were collected. The paper summarizes the obtained results on the wood-decaying fungi of this area, consisting in 95 species distributed in 59 genera, 23 families and 9 orders. Their hosts and substrates were also identified. A checklist of wood-decaying fungi is given. Sequences of the ITS nrRNA gene region of the studied specimens were generated and phylogenetic analysis was performed with maximum likelihood, maximum parsimony and Bayesian inference methods. The present list of wood-decaying fungi enriches the knowledge of fungal diversity worldwide and supplies the basic data for future applications.

Keywords: Basidiomycota; biological resources; diversity; mycota; Wuliangshan area

Citation: He, X.; Zhao, C.-L. Diversity of Wood-Decaying Fungi in Wuliangshan Area, Yunnan Province, P.R. China. *Diversity* **2022**, *14*, 131. https://doi.org/10.3390/d14020131

Academic Editors: Ipek Kurtboke and Michael Wink

Received: 28 January 2022
Accepted: 9 February 2022
Published: 11 February 2022

1. Introduction

Fungi are a diverse, monophyletic group of eukaryotes which have immense ecological and economic impacts. These organisms play an important role in ecosystems as diverse as soil, leaves, trees, wood, and hidden layers within their substrate [1]. Many fungi are microscopic or have cryptic life cycles that make detection difficult, and approximately 140 thousand species of fungi have been described, but the potential biodiversity of the group is likely to be in millions of species [2–4]. The diversity for flora of seed plants in the Yunnan Province is higher than other areas in China, and the endemic species of woody plants are rich, in which both supply good substrates for wood-decaying fungi. Wood-decaying fungi include most basidiomycetes and ascomycetes that grow on various kinds of wood, such as living trees, dead standing trees, fallen trunks, fallen branches and stumps, which can be used for industrial, medicinal, edible and economic value [5–10], and display a considerable ability to transform or degrade different environmental contaminants on their extensive organic compound degradation abilities [1].

The Wuliangshan area is located in the south-central part of the Yunnan Province, China, including the Wuliangshan National Nature Reserve and its surrounding areas, named for its location in the Wuliangshan Mountains. The geographical location is between 100°18′–101°13′ E and 23°12′-24°55′ N [11,12] with an altitude of 2000–3300 m and average annual precipitation more than 1500 mm [11,13]. The plant resources are rich in the Wuliangshan area, with 209 families, 1039 genera and 2574 species of seed plants [11,14]. The mid-mountain wet, semi-wet evergreen broad-leaved forest and monsoon evergreen broad-leaved forest are the main forest communities as the dominant species, which increase the fungal diversity of this area [11,12,15].

The wood-decaying fungi are mostly reported in northwest Yunnan Province, and few polypore and corticioid fungi have been reported there so far. According to the modern taxonomy, wood-decaying fungi mainly belong to ten orders of Agaricomycetes, viz., Agaricales, Auriculariales, Cantharellales, Corticiales, Gloeophyllales, Hymenochaetales, Polyporales, Russulales, Thelephorales and Trechisporales [6,7,16]. Therefore, the current wood-decaying fungi catalogues include poroid and corticioid hymenophores. In the present study, five field trips were carried out in the Wuliangshan area, and about 95 species which are distributed in 59 genera, 23 families, and 9 orders were identified from these materials. The aim of this work was to provide an updated checklist and mapping of wood-decaying fungi in the area, as well as to enrich the knowledge of the fungal diversity in this area.

2. Materials and Methods

2.1. Sample Collection and Herbarium Specimen Preparation

Fresh fruiting bodies of basidiomycetous macrofungi growing on angiosperm stumps, trunks and branches were collected by the systematically surveyed selected cells in the macroarea through the woods for 5 sampling points (approximately the four corners of the square and center) within 1 × 1 km^2 2–3 times every year in the Wuliangshan area of Yunnan Province from October 2017 to January 2019. The fruiting bodies require three basidiomata at least and each individual is up to 3 cm long, 2 cm wide, in which the smallest fruiting structure collected have to include the hymenophore. The samples were photographed in situ and their fresh macroscopic details were recorded. Photographs were recorded by a Jianeng 80D camera. All photos were focus stacked and merged using Helicon Focus software. Macroscopic details were recorded and transported to a field station where the fruit bodies were dried on an electronic food dryer (Fsfruit, Foshan, China) at 45 °C for 48 h. Once dried, the specimens were sealed in envelope and Ziplock plastic bags and labeled. The dried specimens were deposited in the herbarium of Southwest Forestry University (SWFC), Kunming, Yunnan Province.

2.2. Morphological Studies

Macromorphological descriptions were based on field notes. Color terms are from Petersen [17]. Micromorphological data were obtained from the dried specimens and observed under a light microscope following Dai [6]. The following abbreviations were used for the micro characteristics descriptions: KOH = 5% potassium hydroxide, CB = Cotton Blue, CB– = acyanophilous, CB+ = cyanophilous, IKI = Melzer's reagent, IKI– = both inamyloid and indextrinoid, L = mean spore length (arithmetic average of 30 spores), W = mean spore width (arithmetic average of 30 spores), Q = variation in the L/W rationes between the specimens studied, n (a/b) = number of spores (a) measured from given number (b) of specimens.

2.3. Molecular Procedures and Phylogenetic Analysis

CTAB rapid plant genome extraction kit-DN14 (Aidlab Biotechnologies Co., Ltd., Beijing, China) was used to obtain genomic DNA from dried specimens according to the manufacturer's instructions. ITS region was amplified with primer pair ITS5 and ITS4 [18]. The PCR procedure for ITS was as follows: initial denaturation at 95 °C for 3 min, followed by 35 cycles at 94 °C for 40 s, 58 °C for 45 s and 72 °C for 1 min, and a final extension of 72 °C for 10 min. The PCR products were purified using a QIAquick PCR purification kit (Qiagen Inc., Valencia, CA, USA) and directly sequenced at Kunming Tsingke Biological Technology Limited Company, Kunming Yunnan Province, P.R. China. All newly generated sequences were deposited at GenBank (Table 1).

Table 1. List of species, specimens, and GenBank accession numbers of sequences used in this study.

Species Name	Specimen No.	GenBank Accession No. ITS	References	Country
Abundisporus quercicola	CLZhao 10238	MT159978	Present study	China, Yunnan
A. quercicola	Dai 3084	KC415907	[19]	China, Yunnan
Agaricus campestris	MA Fungi 80998	NR_151745	Unpublished	USA, Bethesda
Aleurodiscus botryosus	CBS 336.66	MH858812	[20]	Netherlands, Upsalalaan
A. botryosus	CLZhao 4333	MK343481	Present study	China, Yunnan
A. cerussatus	CLZhao 4715	MK404310	Present study	China, Yunnan
A. cerussatus	SPG 3004	MT831058	[19]	Argentina, Esquel
A. isabellinus	CLZhao 4405	MK343482	Present study	China, Yunnan
A. isabellinus	He 5294	MH109053	[21]	China, Beijing
A. mirabilis	CLZhao 4621	MK343488	Present study	China, Yunnan
A. mirabilis	JMB 2152	MT568513	[19]	Argentina, Esquel
A. subroseus	CLZhao 4722	MK343489	Present study	China, Yunnan
A. subroseus	He 4814	MH109055	[21]	China, Beijing
Antrodia malicola	CLZhao 3832	MH114612	Unpublished	China, Yunnan
Athelia epiphylla	SFC 20180314-01	MK992816	[22]	Korea, Seoul
Auricularia asiatica	CLZhao 3652	MK268844	Present study	China, Yunnan
A. asiatica	OM 13932	MZ618931	[19]	China, Beijing
A. cornea	CLZhao 4245	MK343502	Present study	China, Yunnan
A. cornea	PDD 94825	KX621146	[23]	Thailand, Chiang Rai
A. delicata	CLZhao 4403	MK343505	Present study	China, Yunnan
A. delicata	MFLU162112	KX621149	[23]	Thailand, Chiang Rai
A. mesenterica	BRNM 648573	KP729279	[24]	China, Beijing
Bjerkandera adusta	CLZhao 4310	MK343508	Present study	China, Yunnan
B. adusta	HHB-12826-Sp	KP134983	[25]	USA, Worcester
Boletus edulis	375	EU554664	[26]	Spain, Cabrils
Byssomerulius corium	CLZhao 9318	MT177289	Present study	China, Yunnan
B. corium	FP-102382	KP135007	[25]	USA, Worcester
Cantharellus cibarius	CL-67	MK281467	[27]	Canada, Prince George
Ceriporia lacerata	CLZhao 3693	MK268856	Present study	China, Yunnan
C. lacerata	FP-55521T	KP135024	[25]	USA, Worcester
Cerrena albocinnamomea	CLZhao 4193	MK268860	Present study	China, Yunnan
C. albocinnamomea	Dai 12892	KC485522	[19]	China, Beijing
C. zonata	CLZhao 3502	MK268838	Present study	China, Yunnan
C. zonata	ICMP 16347	MW862786	[19]	New Zealand, Auckland
Climacodon pulcherrimus	CBS 130.40	MH856063	[20]	Netherlands, Upsalalaan
C. pulcherrimus	CLZhao 4379	MK343524	Present study	China, Yunnan
Corticium roseocarneum	CBS 330.66	MH858810	[20]	Netherlands, Upsalalaan
C. roseocarneum	CLZhao 3562	MK268877	Present study	China, Yunnan
C. roseum	CBS 104.52	MH856944	[20]	Netherlands, Upsalalaan
Crustodontia chrysocreas	CLZhao 4143	MK269228	Present study	China, Yunnan
C. chrysocreas	KMRB 18041009	MK120528	[19]	Korea, Seoul
Dacrymyces cyrtosporus	PDD 107980	NR_148190	[28]	USA, Bethesda
D. flabelliformis	PDD 76696	NR_166790	[29]	USA, Bethesda
D. stillatus	UPS F-939814	MN595677	[30]	Sweden, Uppsala
Daedaleopsis confragosa	CLZhao 4260	MK343522	Present study	China, Yunnan
D. confragosa	Cui 2883	KU900526	[19]	China, Beijing
Datronia mollis	CLZhao 4429	MK343523	Present study	China, Yunnan

D. mollis	KUC 20121123-22	KJ668554	[19]	Korea, Seoul
D. stereoides	CLZhao 9937	MT193539	Present study	China, Yunnan
D. stereoides	Cui 8132	JX559270	[19]	China, Beijing
Earliella scabrosa	CLZhao 3722	MK268896	Present study	China, Yunnan
E. scabrosa	Cui 6236	KC867366	[19]	China, Beijing
Fibroporia albicans	CLZhao 4416	MK343526	Present study	China, Yunnan
F. albicans	Dai 10595	NR_153980	[31]	China, Beijing
Flavodon ambrosius	CLZhao 3341	MH114652	Present study	China, Yunnan
F. ambrosius	Hulcr 12546	LC216231	[32]	USA, Gainesville
Fomes fomentarius	CLZhao 4393	MK343528	Present study	China, Yunnan
F. fomentarius	Cui 8020	JX290073	[19]	China, Beijing
Ganoderma australe	CLZhao 4351	MK343538	Present study	China, Yunnan
G. australe	HMAS 86595	AY884184	[19]	China, Beijing
Geastrum pectinatum	MJ 9030	KC581962	[33]	Sweden, Goteborg
Gloeodontia yunnanensis	CLZhao 10504	MN908252	Present study	China, Yunnan
G. yunnanensis	CLZhao 11058	MN908253	Present study	China, Yunnan
Gloeophyllum sepiarium	CBS 293.51	MH856865	[20]	Netherlands, Upsalalaan
G. sepiarium	CLZhao 3473	MK268934	Present study	China, Yunnan
Gomphus clavatus	EL 64/03	EU118628	[34]	Sweden, Goteborg
Heterobasidion insulare	CLZhao 4071	MK268945	Present study	China, Yunnan
H. insulare	Dai 13933	MT146489	[35]	China, Beijing
Hexagonia glabra	CLZhao 3589	MK268955	Present study	China, Yunnan
H. glabra	Cui 16796	MK192431	[36]	China, Beijing
H. tenuis	CLZhao 3485	MK268956	Present study	China, Yunnan
H. tenuis	Cui 8468	JX559277	[37]	China, Beijing
Hymenochaete innexa	CLZhao 4433	MK343546	Present study	China, Yunnan
H. innexa	OUT 855	MT596387	[19]	Italy, Torino
H. xerantica	CLZhao 2789	MK343628	Unpublished	China, Yunnan
Hyphoderma moniliforme	CLZhao 10176	MT246965	Present study	China, Yunnan
H. moniliforme	Wu 0211-46	KC928284	[38]	China, Taiwan
H. mutatum	CBS 291.36	MH855803	[20]	Netherlands, Upsalalaan
H. mutatum	CLZhao 10019	MT246969	Present study	China, Yunnan
H. nudicephalum	CBS 125855	MH863811	[20]	Netherlands, Upsalalaan
H. nudicephalum	CLZhao 3481	MK269020	Present study	China, Yunnan
H. transiens	CLZhao 9628	MT246975	Present study	China, Yunnan
H. transiens	NH 12304	DQ677504	[39]	Sweden, Goteborg
Hysterangium atlanticum	Fungos 2115	NR_165211	[40]	Slovenia, Ljubljana
Irpex lacteus	CLZhao 4338	MK343588	Present study	China, Yunnan
I. lacteus	FD-9	KP135026	[25]	USA, Worcester
Junghuhnia crustacea	CLZhao 3588	MK269088	Present study	China, Yunnan
J. crustacea	X 1127	JN710554	[41]	Finland, Helsinki
J. nitida	CLZhao 3474	MK269086	Present study	China, Yunnan
J. nitida	KHL 11903	EU118638	[34]	Sweden, Goteborg
Laxitextum incrustatum	CLZhao 9273	MT159974	Present study	China, Yunnan
L. incrustatum	STMA 14285	KT722621	[42]	Germany, Braunschweig
Lenzites betulinus	CLZhao 10151	MT193546	Present study	China, Yunnan
L. betulinus	Cui 7095	JX290075	[19]	China, Beijing
Lopharia mirabilis	CLZhao 3518	MK269105	Present study	China, Yunnan
L. mirabilis	Dai 13722	MF626346	[43]	China, Beijing
Lyomyces bambusinus	CLZhao 3675	MN945969	Present study	China, Yunnan

L. bambusinus	CLZhao 4840	MN945971	Present study	China, Yunnan
L. cremeus	CLZhao 4138	MN945974	Present study	China, Yunnan
L. cremeus	CLZhao 8295	MN945972	Present study	China, Yunnan
L. macrosporus	CLZhao 4516	MN945977	Present study	China, Yunnan
L. macrosporus	CLZhao 8605	MN945975	Present study	China, Yunnan
L. wuliangshanensis	CLZhao 4475	MN945983	Present study	China, Yunnan
L. wuliangshanensisd	CLZhao 4108	MN945980	Present study	China, Yunnan
Megasporia ellipsoidea	CLZhao 10360	MT193554	Present study	China, Yunnan
M. ellipsoidea	Cui 5222	JQ314367	[19]	China, Beijing
M. major	CLZhao 10363	MT193555	Present study	China, Yunnan
M. major	Yuan 1183	JQ314365	[19]	China, Beijing
Megasporoporiella pseudocavernulosa	CLZhao 9339	MK894044	Present study	China, Yunnan
M. pseudocavernulosa	Cui 11106	KX900657	[19]	China, Beijing
M. subcavernulosa	CLZhao 4442	MK343599	Present study	China, Yunnan
M. subcavernulosa	Cui 10050	JQ314357	[19]	China, Beijing
Microporus vernicipes	CLZhao 3672	MK269132	Present study	China, Yunnan
M. vernicipes	Dai 7252	KX880619	[19]	China, Beijing
M. xanthopus	CLZhao 4280	MT159985	Present study	China, Yunnan
M. xanthopus	Dai 12076	KX880620	[19]	China, Beijing
Neodatronia sinensis	CLZhao 9471	MT193563	Present study	China, Yunnan
N. sinensis	Cui 9949	KX900663	[19]	China, Beijing
Oxychaete cervinogilva	CLZhao 3462	MK269143	Present study	China, Yunnan
O. cervinogilva	Schigel 5216	KX752596	[44]	Finland, Helsinki
Peniophora cinerea	0911 TES27A5	LN808982	[19]	Spain, Sevilla
P. cinerea	CLZhao 9254	MT159975	Present study	China, Yunnan
P. incarnata	CBS 430.72	MH860518	[20]	Netherlands, Upsalalaan
P. incarnata	CLZhao 9859	MT159976	Present study	China, Yunnan
P. pesudoversicolor	CLZhao 9415	MT159977	Present study	China, Yunnan
P. pseudoversicolor	CBS 338.66	MH858814	[20]	Netherlands, Upsalalaan
Peniophorella fissurata	CLZhao 11412	MN864261	Present study	China, Yunnan
P. fissurata	CLZhao 4539	MN864259	Present study	China, Yunnan
P. pubera	CLZhao 9336	MK894055	Present study	China, Yunnan
P. pubera	NH 10380	DQ647504	[45]	Sweden, Goteborg
P. rude	CLZhao 3360	MH114830	Present study	China, Yunnan
P. rude	Wu 9307-39	DQ647499	[45]	Sweden, Goteborg
Perenniporia luteola	CLZhao 10334	MT193564	Present study	China, Yunnan
P. luteola	Dai 13094	KX900679	[19]	China, Beijing
P. mopanshanensis	CLZhao 4677	MK404422	Present study	China, Yunnan
P. mopanshanensis	CLZhao 5145	MH784912	Present study	China, Yunnan
Phaeophlebiopsis peniophoroides	CLZhao 3637	MK269159	Present study	China, Yunnan
P. peniophoroides	FP-150577	KP135417	[25]	USA, Worcester
Phallus impudicus	KHTW 08001	MG678529	[46]	Brazil, Manaus
Phanerochaete angustocystidiata	CLZhao 9280	MT177305	Present study	China, Yunnan
P. angustocystidiata	KUC20121102-15	KJ668492	[19]	Korea, Seoul
P. australis	CLZhao 3571	MK269240	Present study	China, Yunnan
P. australis	HHB-7105-Sp	KP135081	[25]	USA, Worcester
P. concrescens	CLZhao 4367	MK404430	Present study	China, Yunnan
P. concrescens	Spirin 6111	KP994352	[47]	Russia, Saint-Petersburg
P. sanguineocarnosa	CLZhao 4447	MK343613	Present study	China, Yunnan
P. sanguineocarnosa	HHB-2189	KP135124	[25]	USA, Worcester

P. sordida	CLZhao 3407	MK269174	Present study	China, Yunnan
P. sordida	FD-241	KP135136	[25]	USA, Worcester
Phlebiopsis castanea	CLZhao 3501	MK269230	Present study	China, Yunnan
P. castanea	Spirin 5295	KX752610	[44]	Finland, Helsinki
P. crassa	CLZhao 3339	MT177325	Present study	China, Yunnan
P. crassa	KKN-86	KP135394	[25]	USA, Worcester
Rhomboidia wuliangshanensis	CLZhao 4406	MK860715	Present study	China, Yunnan
R. wuliangshanensis	CLZhao 4411	MK860716	Present study	China, Yunnan
Rigidoporus pouzarii	CLZhao 4524	MK404499	Present study	China, Yunnan
R. pouzarii	MJ 123_93	JQ409464	[19]	Czech Republic, South Bohemia
Russula recondita	LUG 19058	NR_147635	[48]	USA, Bethesda
Sebacina incrustans	JMP 0084	EU819442	[49]	USA, Wisconsin
Serpula dendrocalami	CLZhao 3136	MK863399	Present study	China, Yunnan
S. dendrocalami	CLZhao 3607	MK863404	Present study	China, Yunnan
Sistotrema brinkmannii	ATCC 36164	DQ899095	[19]	USA, Stillwater
S. brinkmannii	CLZhao 9324	MT159987	Present study	China, Yunnan
Sistotremastrum guttuliferum	BHI-F755a	MW488061	[19]	USA, West Lafayette
S. guttuliferum	CLZhao 9771	MT159990	Present study	China, Yunnan
Steccherinum bourdotii	CLZhao 4297	MK343648	Present study	China, Yunnan
S. bourdotii	U 107	MN749593	[50]	Arabia, Hail
S. ochraceum	CLZhao 4154	MK404504	Present study	China, Yunnan
S. ochraceum	LE-BIN 3984	MK795064	[19]	Russia, Saint Petersburg
Terana coerulea	CLZhao 9803	MT177329	Present study	China, Yunnan
T. coerulea	FP-104073	KP134980	[25]	USA, Worcester
Thelephora terrestris	JMP 0086	EU819444	[49]	USA, La Crosse
Tinctoporellus epimiltinus	CLZhao 3605	MK269225	Present study	China, Yunnan
T. epimiltinus	PR1147	KY948721	[51]	USA, Massachusetts
Trametes ellipsosopia	CLZhao 3774	MK269226	Present study	China, Yunnan
T. ellipsospora	Cui 6259	JN048767	[52]	China, Beijing
T. hirsuta	CLZhao 3572	MK269220	Present study	China, Yunnan
T. hirsuta	TH 158	MF960866	[53]	Czech Republic, Brno
T. pavonia	CLZhao 3740	MK269222	Present study	China, Yunnan
T. pavonia	PR2178	JN164959	[54]	USA, Worcester
T. versicolor	CLZhao 4170	MK269115	Present study	China, Yunnan
T. versicolor	F-1599	MN749366	[19]	USA, West Lafayette
Trametopsis cervina	CLZhao 9449	MW418032	Present study	China, Yunnan
T. cervina	TJV 93_216T	JN165020	[54]	USA, Worcester
Trechispora echinospora	MA-Fungi 82485	JX392847	[55]	Spain, Madrid
T. nivea	A 1683	MT458536	[19]	Greece, Athens
T. nivea	CLZhao 10154	MT159996	Present study	China, Yunnan
Truncospora ochroleuca	CLZhao 4350	MK343685	Present study	China, Yunnan
T. ochroleuca	BCC 16648	KP059107	[19]	Thailand, Khlong

Sequencher 4.6 (GeneCodes, Ann Arbor, MI, USA) was used to edit the DNA sequence. Sequences were aligned in MAFFT 7 (http://mafft.cbrc.jp/alignment/server/, accessed on 15 November 2021) using the "G-INS-i" strategy and manually adjusted in BioEdit [56]. Sequence of Dacrymyces from type species as *D. stillatus* Nees obtained from GenBank was used as an outgroup to root tree following James et al. [1] in ITS analysis (Figure 1). Sequences from type materials of *Dacrymyces flabelliformis* Burds. and Laursen and *D. cyrtosporus* Shirouzu acquired from GenBank were utilized as another outgroup to root tree following James et al. [1] in ITS analysis (Figure 2).

Maximum parsimony analysis was applied to the ITS dataset sequences. Approaches to phylogenetic analysis followed Zhao and Wu [57] and the tree construction procedure was performed in PAUP* version 4.0b10 [58]. All characters were equally weighted and gaps were treated as missing data. Trees were inferred using the heuristic search option with TBR branch swapping and 1000 random sequence additions. Max-trees were set to 5000, branches of zero length were collapsed and all parsimonious trees were saved. Clade robustness was assessed using a bootstrap (BT) analysis with 1000 replicates [59]. Descriptive tree statistics tree length (TL), consistency index (CI), retention index (RI), rescaled consistency index (RC), and homoplasy index (HI) were calculated for each Maximum Parsimonious Tree (MPT) generated. Sequences were also analyzed using maximum likelihood (ML) with RAxML-HPC2 through the Cipres Science Gateway [60]. Branch support (BS) for ML analysis was determined by 1000 bootstrap replicates.

MrModeltest 2.3 [61] was used to determine the best-fit evolution model for each data set for Bayesian inference (BI). Bayesian inference was calculated with MrBayes3.1.2 with a general time reversible (GTR+I+G) model of DNA substitution and a gamma distribution rate variation across sites [62]. Four Markov chains were run for 2 runs from random starting trees for 760 thousand generations (Figure 1) and 6.4 million generations (Figure 2), and trees were sampled every 100 generations. The first one-fourth generations were discarded as burn-in. A majority rule consensus tree of all remaining trees was calculated. Branches were considered as significantly supported if they received maximum likelihood bootstrap (BS) >70%, maximum parsimony bootstrap (BT) >50%, or Bayesian posterior probabilities (BPP) >0.95.

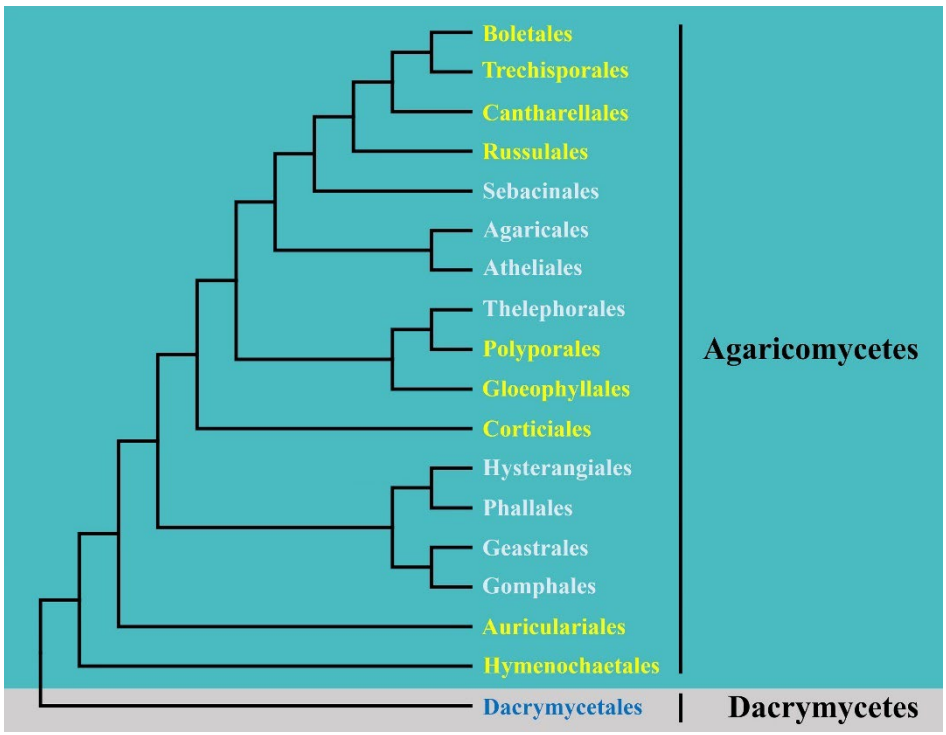
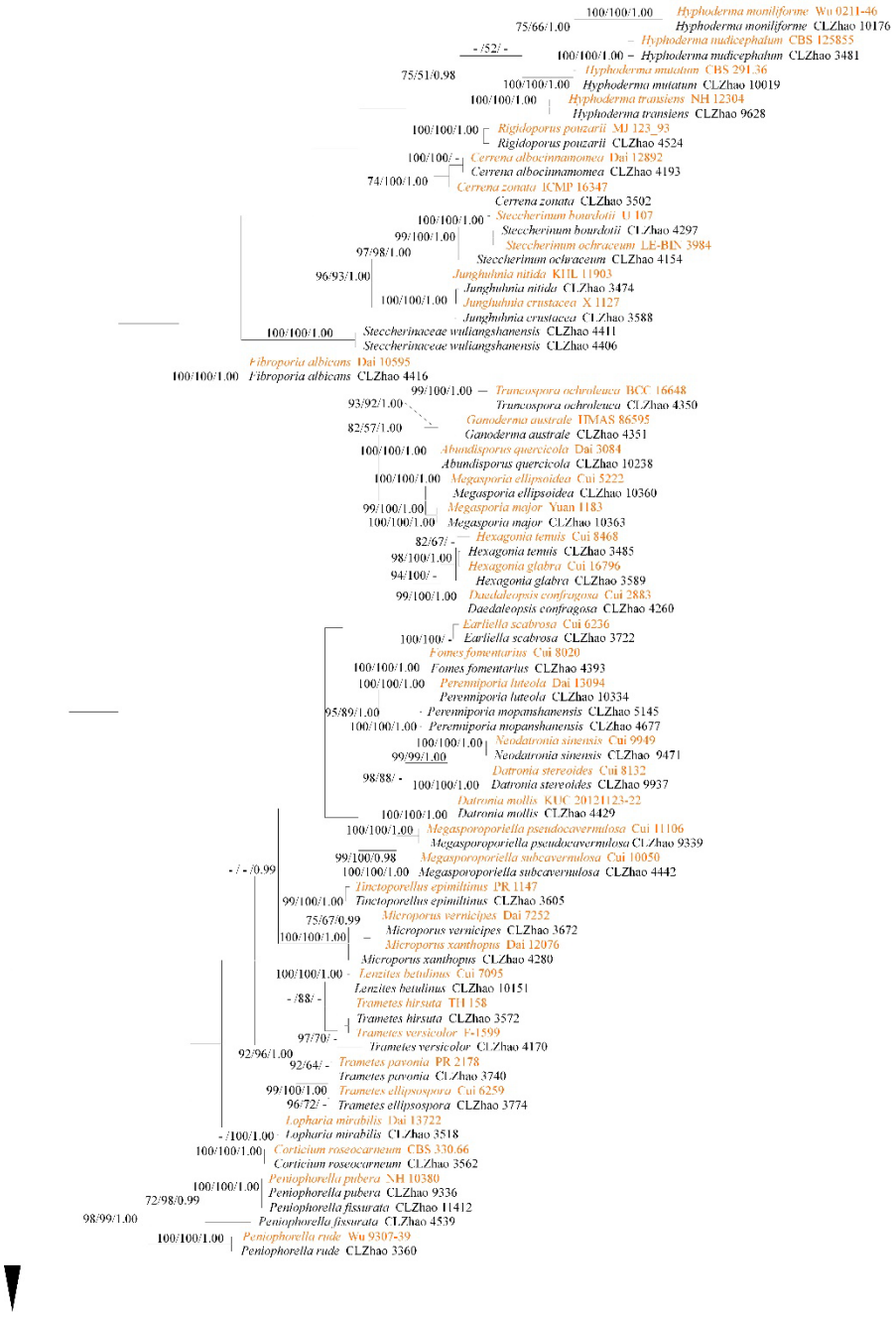


Figure 1. Maximum parsimony strict consensus tree illustrating the phylogeny of 9 orders in Agaricomycetes based on ITS sequences. Branches are labeled with maximum likelihood bootstrap >70%, parsimony bootstrap >50% and Bayesian posterior probabilities >0.97, respectively. The 9 orders conducted in present studies are labeled in light yellow.


100/100/1.00 Hyphoderma moniliforme Wu 0211-46
75/66/1.00 Hyphoderma moniliforme CLZhao 10176
Hyphoderma nudicephalum CBS 125855
-/52/- 100/100/1.00 Hyphoderma nudicephalum CLZhao 3481
Hyphoderma mutatum CBS 291.36
75/51/0.98 100/100/1.00 Hyphoderma mutatum CLZhao 10019
100/100/1.00 Hyphoderma transiens NH 12304
Hyphoderma transiens CLZhao 9628
100/100/1.00 Rigidoporus ponzarii MJ 123_93
Rigidoporus ponzarii CLZhao 4524
100/100/- Cerrena albocinnamomea Dai 12892
Cerrena albocinnamomea CLZhao 4193
74/100/1.00 Cerrena zonata ICMP 16347
Cerrena zonata CLZhao 3502
100/100/1.00 Steccherinum bourdotii U 107
99/100/1.00 Steccherinum bourdotii CLZhao 4297
Steccherinum ochraceum LE-BIN 3984
97/98/1.00 Steccherinum ochraceum CLZhao 4154
Junghuhnia nitida KHL 11903
96/93/1.00 Junghuhnia nitida CLZhao 3474
100/100/1.00 Junghuhnia crustacea X 1127
Junghuhnia crustacea CLZhao 3588
100/100/1.00 Steccherinaceae wuliangshanensis CLZhao 4411
Steccherinaceae wuliangshanensis CLZhao 4406
Fibroporia albicans Dai 10595
100/100/1.00 Fibroporia albicans CLZhao 4416
99/100/1.00 Truncospora ochroleuca BCC 16648
93/92/1.00 Truncospora ochroleuca CLZhao 4350
Ganoderma australe TIMAS 86595
82/57/1.00 Ganoderma australe CLZhao 4351
100/100/1.00 Abundisporus quercicola Dai 3084
Abundisporus quercicola CLZhao 10238
100/100/1.00 Megasporia ellipsoidea Cui 5222
Megasporia ellipsoidea CLZhao 10360
99/100/1.00 Megasporia major Yuan 1183
100/100/1.00 Megasporia major CLZhao 10363
82/67/- Hexagonia tenuis Cui 8468
98/100/1.00 Hexagonia tenuis CLZhao 3485
94/100/- Hexagonia glabra Cui 16796
Hexagonia glabra CLZhao 3589
99/100/1.00 Daedaleopsis confragosa Cui 2883
Daedaleopsis confragosa CLZhao 4260
Earliella scabrosa Cui 6236
100/100/- Earliella scabrosa CLZhao 3722
Fomes fomentarius Cui 8020
100/100/1.00 Fomes fomentarius CLZhao 4393
100/100/1.00 Peremiporia luteola Dai 13094
Peremiporia luteola CLZhao 10334
95/89/1.00 Peremiporia mopanshanensis CLZhao 5145
100/100/1.00 Peremiporia mopanshanensis CLZhao 4677
100/100/1.00 Neodatronia sinensis Cui 9949
99/99/1.00 Neodatronia sinensis CLZhao 9471
Datronia stereoides Cui 8132
98/88/- 100/100/1.00 Datronia stereoides CLZhao 9937
Datronia mollis KUC 20121123-22
100/100/1.00 Datronia mollis CLZhao 4429
100/100/1.00 Megasporoporiella pseudocavernulosa Cui 11106
Megasporoporiella pseudocavernulosa CLZhao 9339
99/100/0.98 Megasporoporiella subcavernulosa Cui 10050
-/-/0.99 100/100/1.00 Megasporoporiella subcavernulosa CLZhao 4442
Tinctoporellus epimiltinus PR 1147
99/100/1.00 Tinctoporellus epimiltinus CLZhao 3605
75/67/0.99 Microporus vernicipes Dai 7252
Microporus vernicipes CLZhao 3672
100/100/1.00 Microporus xanthopus Dai 12076
Microporus xanthopus CLZhao 4280
100/100/1.00 Lenzites betulinus Cui 7095
Lenzites betulinus CLZhao 10151
-/88/- Trametes hirsuta TH 158
Trametes hirsuta CLZhao 3572
97/70/- Trametes versicolor F-1599
Trametes versicolor CLZhao 4170
92/96/1.00 92/64/- Trametes pavonia PR 2178
Trametes pavonia CLZhao 3740
99/100/1.00 Trametes ellipsospora Cui 6259
96/72/- Trametes ellipsospora CLZhao 3774
Lopharia mirabilis Dai 13722
-/100/1.00 Lopharia mirabilis CLZhao 3518
100/100/1.00 Corticium roseocarneum CBS 330.66
Corticium roseocarneum CLZhao 3562
100/100/1.00 Peniophorella pubera NH 10380
72/98/0.99 Peniophorella pubera CLZhao 9336
Peniophorella fissurata CLZhao 11412
98/99/1.00 Peniophorella fissurata CLZhao 4539
100/100/1.00 Peniophorella rude Wu 9307-39
Peniophorella rude CLZhao 3360

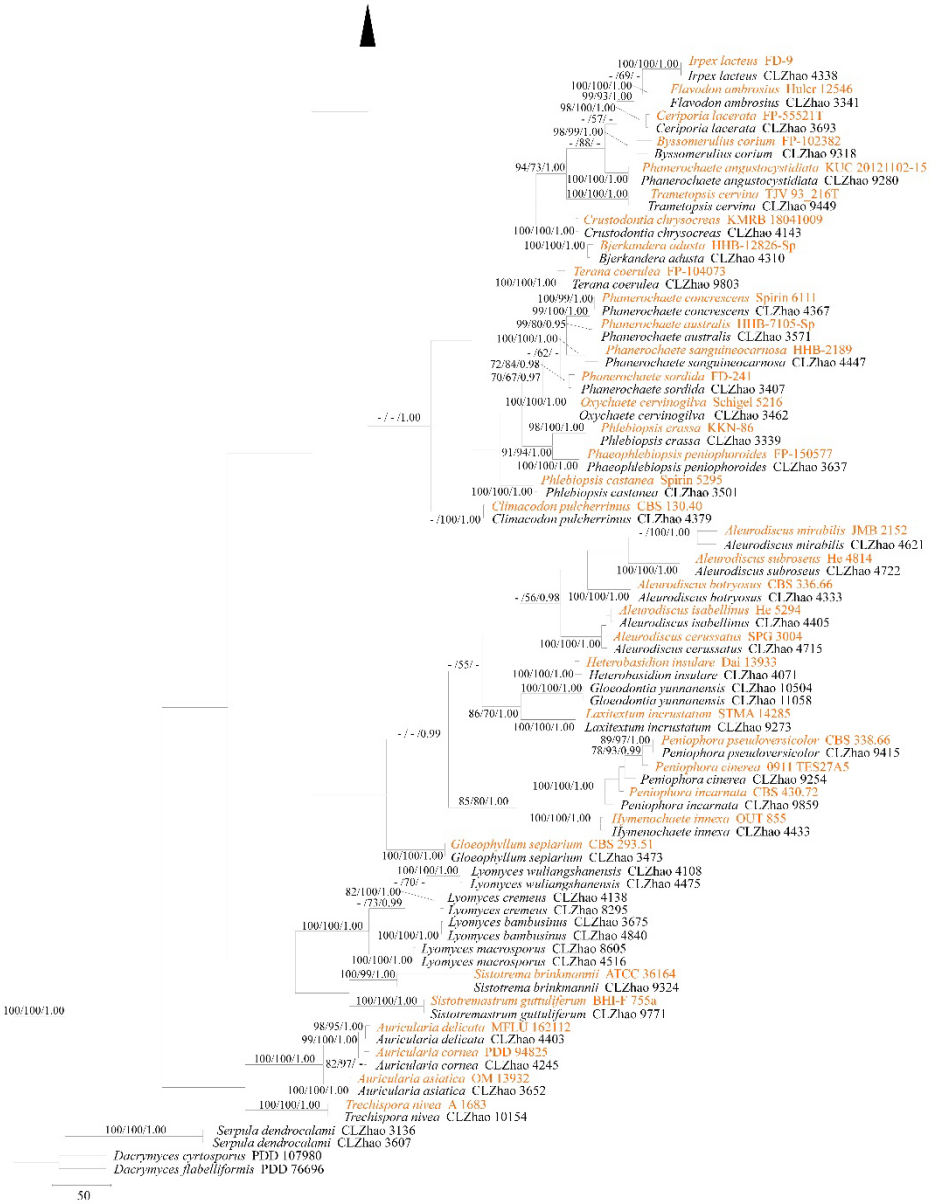


Figure 2. Maximum parsimony strict consensus tree illustrating the phylogeny of 85 species in Agaricomycetes based on ITS sequences. Branches are labeled with maximum likelihood bootstrap >70%, parsimony bootstrap >50% and Bayesian posterior probabilities >0.97, respectively. The sequences of collections labeled in orange are downloaded from GenBank, while those in black are generated in this study.

3. Results

3.1. Molecular Phylogeny

The ITS dataset (Figure 1) included sequences from 18 fungal specimens representing 18 species. The dataset had an aligned length of 1017 characters, of which 326 characters were constant, 272 parsimony-uninformative, and 419 parsimony-informative. Maximum parsimony analysis yielded three equally parsimonious trees (TL = 2801, CI = 0.4763, HI = 0.5237, RI = 0.0259, RC = 0.0123). The best-fit model for ITS alignment estimated and applied in the Bayesian method was GTR+I+G, lset nst = 6, rates = invgamma; prset statefreqpr = dirichlet (1,1,1,1). The Bayesian method resulted in a similar topology with an average standard deviation of split frequencies = 0.009891 (BI).

The phylogeny (Figure 1) inferred from ITS sequences demonstrated that ninety-five species nested in nine orders, including Auriculariales, Boletales, Cantharellales, Corticiales, Gloeophyllales, Hymenochaetales, Polyporales, Russulales and Trechisporales of Agaricomycetes.

The ITS dataset (Figure 2) included sequences from 172 fungal specimens representing 87 species. The dataset had an aligned length of 1107 characters, of which 351 characters were constant, 52 parsimony-uninformative, and 704 parsimony-informative. Maximum parsimony analysis yielded 10 equally parsimonious trees (TL = 7174, CI = 0.2319, HI = 0.7681, RI = 0.6952, RC = 0.1613). The best-fit model for ITS alignment estimated and applied in the Bayesian method was GTR+I+G, lset nst = 6, rates = invgamma; prset statefreqpr = dirichlet (1,1,1,1). The Bayesian method resulted in a similar topology with an average standard deviation of split frequencies = 0.012495 (BI), and the effective sample size (ESS) across the two runs is the double of the average ESS (avg ESS) = 223.5.

The phylogeny (Figure 2) inferred from ITS sequences demonstrated that 2454 specimens of wood-decaying fungi belonged to 85 taxa and all of them nested into class Agaricomycetes.

3.2. Checklist

An alphabetical list (according to genus name) of wood-decaying fungi identified in these investigations is given below. The authors of scientific names are according to the second edition of *Authors of Fungal Names* (http://www.indexfungorum.org/AuthorsOfFungalNames.htm, accessed on 15 November 2021). Substrate and collecting data are provided after the name of each species. The hosts are listed alphabetically, and within the same host tree, they are arranged by the following order: living tree, dead standing tree, trunk, fallen branch and stump. The collectors and collection numbers are listed alphabetically as well [6,63].

Abundisporus quercicola Y.C. Dai, in Dai, Niemelä and Kinnunen, Ann. bot. fenn. 39(3): 171 (2002).

Specimens examined: on dead tree of angiosperm, 9 January 2019, CLZhao 10238; on the trunk of angiosperm, 10 January 2019, CLZhao 10,381 (SWFC).

Distribution: Asia—China [64].

Aleurodiscus botryosus Burt, Ann. Mo. bot. Gdn 5: 198 (1918).

Specimens examined: on the fallen angiosperm branch, 5 October 2017, CLZhao 4333 (SWFC).

Distribution: Asia—China; Europe—France Portugal, Spain the United Kingdom; North America—Canada the United States; Oceania—Australia, New Zealand [64].

Aleurodiscus cerussatus (Bres.) Höhn. and Litsch., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 116: 808 (1907).

Specimens examined: on the fallen branch of angiosperm, 6 October 2017, CLZhao 4715 (SWFC).

Distribution: Asia—China; Europe—Denmark, Estonia, Italy, Norway, Russia, Spain, Sweden; North America—the United States; South America—Argentina; Oceania—Australia [64].

Aleurodiscus isabellinus S.H. He and Y.C. Dai, in Tian, Ghobad-Nejhad, He and Dai, MycoKeys 37: 100 (2018).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4102; 6 October 2017, CLZhao 4405, CLZhao 4600; 4 January 2019, CLZhao 9300; on the fallen branch of angiosperm, 5 October 2017, CLZhao 4369, CLZhao 4435, CLZhao 4510, CLZhao 4564, CLZhao 4718; 4 January 2019, CLZhao 9284, CLZhao 9359, CLZhao 9364, CLZhao 9615, CLZhao 9643; 7 January 2019, CLZhao 9781, CLZhao 9861; 9 January 2019, CLZhao 10,095 (SWFC).

Distribution: Asia—China [64].

Aleurodiscus mirabilis (Berk. and M.A. Curtis) Höhn., Sber. Akad. Wiss. Wien, Math.-naturw. Kl., Abt. 1 118: 818 (1909).

Specimens examined: on the fallen branch of angiosperm, 6 October 2017, CLZhao 4621 (SWFC).

Distribution: Africa—Gabon, Mauritius, Tanzania; Asia—China, Japan, Sri Lanka; North America—Cuba, Jamaica, the United States; South America—Brazil, Colombia, Ecuador, Venezuela; Oceania—Australia, New Zealand [64].

Aleurodiscus subroseus S.H. He and Y.C. Dai, in Tian, Ghobad-Nejhad, He and Dai, MycoKeys 37: 102 (2018).

Specimens examined: on the fallen branch of angiosperm, 6 October 2017, CLZhao 4722 (SWFC).

Distribution: Asia—China [64].

Asterostroma muscicola (Berk. and M.A. Curtis) Massee, J. Linn. Soc., Bot. 25(no. 170): 155 (1889).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3577 (SWFC).

Distribution: Africa—Malawi, Rwanda, Tanzania; Asia—China, India, Indonesia; North America—Bahamas, Cuba, Canada, Jamaica, Mexico, the United States; South America—Brazil, Colombia, Venezuela; Oceania—Australia [64].

Auricularia asiatica Bandara and K.D. Hyde, in Bandara, Karunarathna, Phillips, Mortimer, Xu, Kakumyan and Hyde, Phytotaxa 292(1): 24 (2016).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3652 (SWFC).

Distribution: Asia—China, Thailand [64].

Auricularia cornea Ehrenb., in Nees von Esenbeck (Ed.), Horae Phys. Berol.: 91 (1820).

Specimens examined: on the dead tree of angiosperm, 9 January 2019, CLZhao 10129; on the trunk of angiosperm, 5 October 2017, CLZhao 4245, CLZhao 4282, CLZhao 4306, CLZhao 4483; 4 January 2019, CLZhao 9272, CLZhao 9330; 9 January 2019, CLZhao 10009, CLZhao 10,324 (SWFC).

Distribution: Africa—South Africa, Tanzania; Asia—China, Indonesia; North America—Mexico, the United States; South America—Brazil [64].

Auricularia delicata (Mont. ex Fr.) Henn., Bot. Jb. 17: 492 (1893).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4403, CLZhao 4582 (SWFC).

Distribution: Asia—China, India; North America—Mexico, the United States [64].

Bjerkandera adusta (Willd.) P. Karst., Meddn Soc. Fauna Flora fenn. 5: 38 (1879).

Specimens examined: on the fallen branch of angiosperm, 5 October 2017, CLZhao 4310; 6 October 2017, CLZhao 4371, CLZhao 4374, CLZhao 4376, CLZhao 4427, CLZhao 4444, CLZhao 4546, CLZhao 4625, CLZhao 4637; 7 January 2019, CLZhao 9844; 4 January 2019, CLZhao 9345; 5 January 2019, CLZhao 9508; 10 January 2019, CLZhao 10385, CLZhao 10,404 (SWFC).

Distribution: Asia—China, India, Japan, Pakistan, Thailand, Vietnam; Europe—Bulgaria, Finland, Germany, Italy, Norway, Poland, Russia, Spain, Sweden, the United Kingdom, Ukraine; North America—Canada, the United States [64].

Byssomerulius corium (Pers.) Parmasto, Eesti NSV Tead. Akad. Toim., Biol. seer 16(4): 383 (1967).

Specimens examined: on the trunk of angiosperm, 4 January 2019, CLZhao 9318; on the fallen branch of angiosperm, 4 January 2019, CLZhao 9390, CLZhao 10,110 (SWFC).

Distribution: Asia—China, Turkey; Europe—Belgium, Croatia, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Norway, Poland, Portugal, Romania, Serbia, Spain, Sweden, Switzerland, the United Kingdom, Ukraine [64].

Ceriporia lacerata N. Maek., Suhara and R. Kondo, in Suhara, Maekawa, Kaneko, Hattori, Sakai and Kondo, Mycotaxon 86: 342 (2003).

Specimens examined: on the trunk of angiosperm, 3 October 2017, CLZhao 3693 (SWFC).

Distribution: Asia—China, Japan; Europe—Finland; North America—the United States [64].

Cerrena albocinnamomea (Y.C. Dai and Niemelä) H.S. Yuan, Mycol. Progr. 13(2): 362 (2013).

Specimens examined: on the fallen branch of *Alnus nepalensis*, 4 January 2019, CLZhao 9281; on the trunk of angiosperm, 5 October 2017, CLZhao 4197; 4 January 2019, CLZhao 9270, CLZhao 9342; on the fallen branch of angiosperm, 5 October 2017, CLZhao 4193 (SWFC).

Distribution: Asia—China, India, Japan, South Korea [64].

Cerrena zonata (Berk.) H.S. Yuan, Mycol. Progr. 13(2): 363 (2013).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3581; 5 October 2017, CLZhao 4178; 6 January 2019, CLZhao 9633, CLZhao 9641; on the fallen branch of angiosperm, 2 October 2017, CLZhao 3502 (SWFC).

Distribution: Asia—China, India, Japan, Thailand, Vietnam; Europe—Russia; South America—Argentina; Oceania—Australia, New Zealand [64].

Climacodon pulcherrimus (Berk. and M.A. Curtis) Nikol., Flora Plantarum Cryptogamarum URSS 6, Fungi 6(Fungi, 2): 194 (1961).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4379 (SWFC).

Distribution: Asia—China; Europe—Belarus, France, Spain, Ukraine [64].

Corticium roseocarneum (Schwein.) Hjortstam, Windahlia 23: 2 (1998).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4719; on the fallen branch of angiosperm, 6 October 2017, CLZhao 4545, CLZhao 4735; 7 January 2019, CLZhao 9815; on the trunk of *Pinus*, 2 October 2017, CLZhao 3562 (SWFC).

Distribution: Asia—China, Japan; Europe—France, Norway; North America—Canada [64].

Crustodontia chrysocreas (Berk. and M.A. Curtis) Hjortstam and Ryvarden, Syn. Fung. (Oslo) 20: 36 (2005).

Specimens examined: on the fallen branch of angiosperm, 5 October 2017, CLZhao 4143; 7 January 2019, CLZhao 9831 (SWFC).

Distribution: Asia—China; Europe—Belarus, France [64].

Dacryobolus angiospermarum S.H. He, in Xu, Liu, Wu and He, Phytotaxa 365(2): 190 (2018).

Specimens examined: on the fallen branch of *Pinus*, 3 October 2017, CLZhao 3706 (SWFC).

Distribution: Asia—China [64].

Daedaleopsis confragosa (Bolton) J. Schröt., in Cohn, Krypt.-Fl. Schlesien (Breslau) 3.1(25–32): 492 (1888).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4260; on the stump of angiosperm, 10 January 2019, CLZhao 10379, CLZhao 10,447 (SWFC).

Distribution: Africa—Nigeria, South Africa; Asia—China, Azerbaijan, Bhutan, India, Iran, Japan, Malaysia, Nepal, North Korea; Europe—Andorra, Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland,

Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, the United Kingdom, Ukraine; North America—Canada, Mexico, the United States; South America—Brazil, Venezuela; Oceania—Australia [64].

Datronia mollis (Sommerf.) Donk, Persoonia 4(3): 338 (1966).

Specimens examined: on dead tree of angiosperm, 6 October 2017, CLZhao 4429; on the trunk of angiosperm, 4 January 2019, CLZhao 9326 (SWFC).

Distribution: Asia—China; Europe—Russia; North America—the United States [64].

Datronia stereoides (Fr.) Ryvarden, Blyttia 25: 168 (1967).

Specimens examined: on the fallen branch of angiosperm, 7 January 2019, CLZhao 9937 (SWFC).

Distribution: Asia—China, Japan, Kyrgyzstan, North Korea; Europe—Austria, Finland, France, Hungary, Norway, Russia, Spain, Sweden, Switzerland, the United Kingdom; North America—Canada, Costa Rica, Honduras, Mexico, the United States; South America—Brazil, Colombia, Guyana, Paraguay, Venezuela; Oceania—Australia [64].

Earliella scabrosa (Pers.) Gilb. and Ryvarden, Mycotaxon 22(2): 364 (1985).

Specimens examined: on the trunk of angiosperm, 3 October 2017, CLZhao 3688, CLZhao 3701, CLZhao 3722, CLZhao 3754, CLZhao 3766; on the stump of angiosperm, 3 October 2017, CLZhao 3730 (SWFC).

Distribution: Asia—China, India, Malaysia, Philippines, Sri Lanka; North America—the United States [64].

Fibroporia albicans B.K. Cui and Yuan Y. Chen, in Chen, Li and Cui, Phytotaxa 203(1): 51 (2015).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4416 (SWFC).

Distribution: Asia—China [64].

Flavodon ambrosius D.R. Simmons, You Li, C.C. Bateman and J. Hulcr, Mycotaxon 131(2): 279 (2016).

Specimens examined: on the trunk of angiosperm, 1 October 2017, CLZhao 3341 (SWFC).

Distribution: Asia—China; North America—the United States [64].

Fomes fomentarius (L.) Fr., Summa veg. Scand., Sectio Post. (Stockholm): 321 (1849).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4393 (SWFC).

Distribution: Asia—China, Japan; Europe—Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, Luxembourg, Netherlands, Norway, Poland, Russia, Slovenia, Spain, Sweden, the United Kingdom, Ukraine; North America—Canada, the United States [64].

Ganoderma australe (Fr.) Pat., Bull. Soc. mycol. Fr. 5(2,3): 65 (1889) (Figure 3).

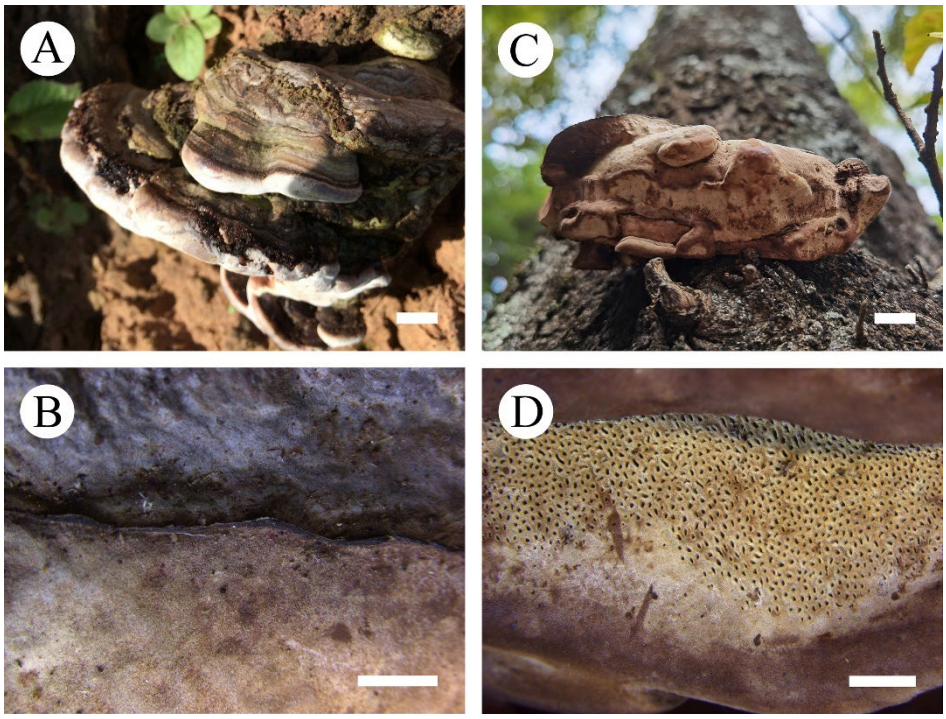


Figure 3. Basidiomata in situ of *Ganoderma australe*. (**A**,**B**) The front of the basidiomata; (**C**) the back of the basidiomata; (**D**) a section of hymenophore. Bars: A = C = 1 cm; B = D = 2 mm.

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4351 (SWFC).

Distribution: Asia—China; Europe—France, the United Kingdom; North America—Canada, the United States; Oceania—Australia, New Zealand [64].

Gloeodontia yunnanensis C.L. Zhao, in Chen, Shi, Wu and Zhao, Phytotaxa 432(2): 115 (2020).

Specimens examined: on angiosperm trunk, 10 January 2019, CLZhao 10,504 (SWFC).

Distribution: Asia—China [64].

Gloeophyllum sepiarium (Wulfen) P. Karst. (as 'Gleophyllum'), Bidr. Känn. Finl. Nat. Folk 37: 79 (1882) (Figure 4).

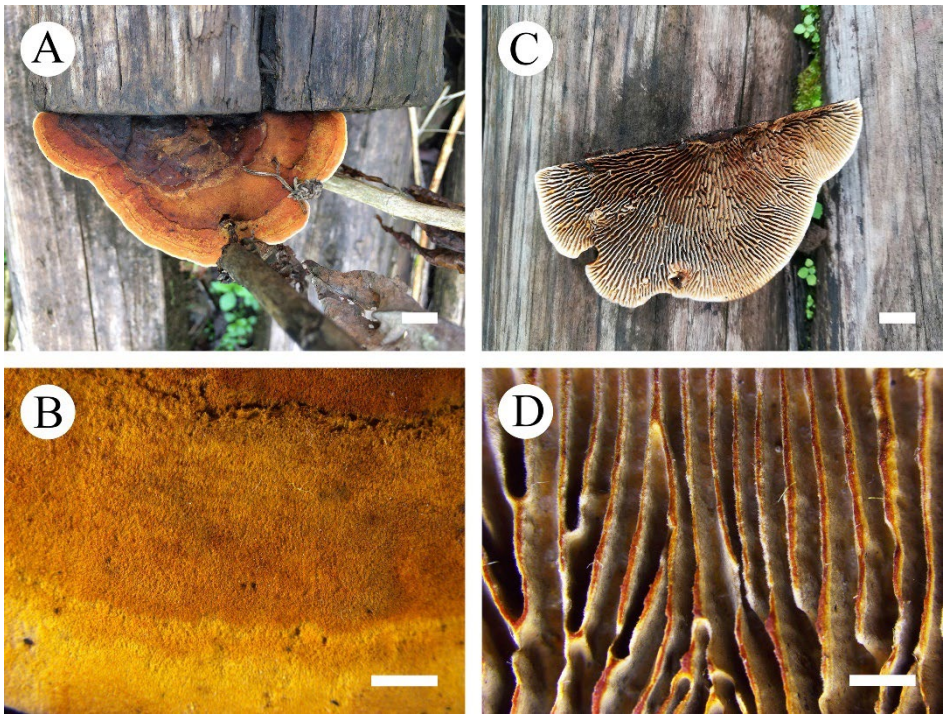


Figure 4. Basidiomata in situ of *Gloeophyllum sepiarium*. (**A**,**B**) The front of the basidiomata; (**C**) the back of the basidiomata; (**D**) a section of hymenophore. Bars: A = C = 1 cm; B = D = 2 mm.

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3473, CLZhao 3500, CLZhao 3555, CLZhao 3559, CLZhao 3575; 5 October 2017, CLZhao 4155; 6 October 2017, CLZhao 4532; on the fallen branch of *Pinus*, 3 October 2017, CLZhao 3680 (SWFC).

Distribution: Asia—China, Japan; Europe—Russia; North America—the United States [64].

Gyrodontium sacchari (Spreng.) Hjortstam, Mycotaxon 54: 186 (1995).

Specimens examined: on the stump of angiosperm, 3 October 2017, CLZhao 3572 (SWFC).

Distribution: Asia—China, India; Europe—Belgium, Italy, Sweden; North America—Mexico [64].

Heterobasidion insulare (Murrill) Ryvarden (as 'insularis'), Norw. Jl Bot. 19: 237 (1972) (Figure 5).

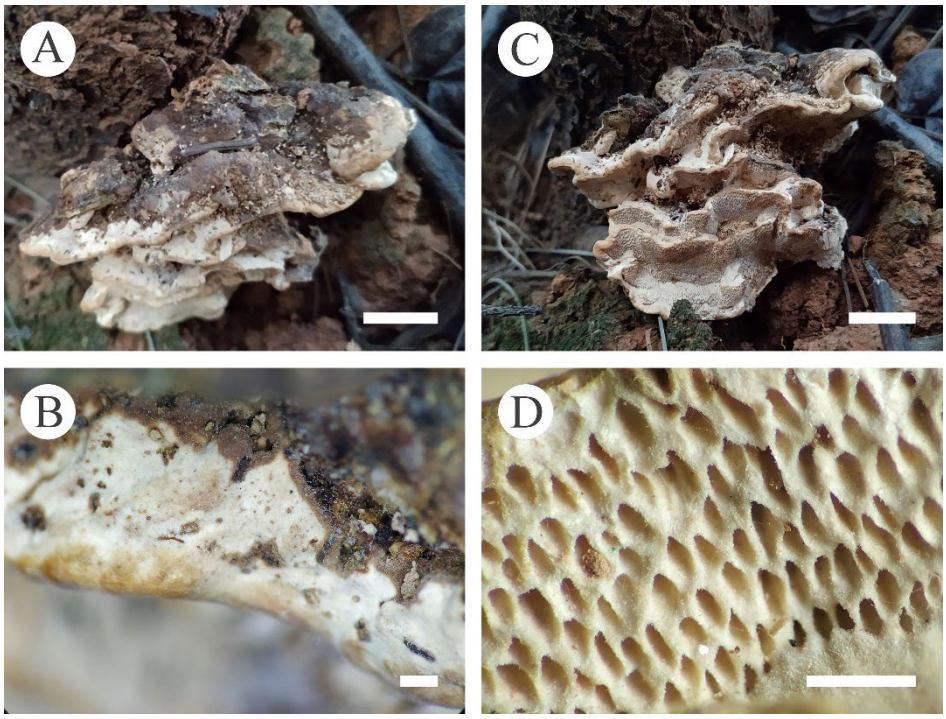


Figure 5. Basidiomata in situ of *Heterobasidion insulare*. (**A**,**B**) The front of the basidiomata; (**C**) the back of the basidiomata; (**D**) a section of hymenophore. Bars: A = C = 1 cm; B = D = 1 mm.

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4071, CLZhao 4132, CLZhao 4145, CLZhao 4220, CLZhao 4363; on the stump of angiosperm, 5 October 2017, CLZhao 4224; on the trunk of *Pinus*, 5 October 2017, CLZhao 4216 (SWFC).

Distribution: Asia—China, India, Japan, Korea, Myanmar, Nepal, South Korea; Europe—Russia [64].

Hexagonia glabra (P. Beauv.) Ryvarden (as 'glaber'), Mycotaxon 72: 216 (1999).

Specimens examined: on the fallen branch of angiosperm, 2 October 2017, CLZhao 3589 (SWFC).

Distribution: Africa—Tanzania, Mauritius; Asia—China, India, Japan, Philippines, Thailand, Vietnam; North America—Costa Rica; South America—Brazil; Oceania—Australia [64].

Hexagonia tenuis (Fr.) Fr., Epicr. syst. mycol. (Upsaliae): 498 (1838).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3485, CLZhao 3498 (SWFC).

Distribution: Asia—China, India, Japan, Malaysia, Philippines, Sri Lanka. Oceania—Australia [64].

Hydnoporia corrugata (Fr.) K.H. Larss. and Spirin, in Miettinen, Larsson and Spirin, Fungal Systematics and Evolution 4: 88 (2019).

Specimens examined: on the fallen branch of angiosperm, 7 January 2019, CLZhao 9913; 9 January 2019, CLZhao 10170, CLZhao 10207; 10 January 2019, CLZhao 10344, CLZhao 10,362 (SWFC).

Distribution: Asia—China, Japan, Sri Lanka; Europe—Denmark, France, Germany, Ireland, Netherlands, Norway, Russia, Spain, Sweden, Switzerland, the United Kingdom, Yugoslavia; North America—Canada, the United States; South America—Argentina, Colombia; Oceania—New Zealand [64].

Hymenochaete berteroi Pat., Bull. Soc. mycol. Fr. 10(2): 78 (1894).

Specimens examined: on the fallen branch of angiosperm, 5 October 2017, CLZhao 4203, CLZhao 4328 (SWFC).

Distribution: Africa—Kenya, Malawi, Tanzania; Asia—China; North America—Costa Rica; South America—Venezuela [64].

Hymenochaete innexa G. Cunn., Trans. Roy. Soc. N.Z. 85(1): 47 (1957).

Specimens examined: on the fallen branch of angiosperm, 6 October 2017, CLZhao 4433, CLZhao 4458, CLZhao 4584, CLZhao 4586, CLZhao 4731; 3 January 2019, CLZhao 9255; 5 January 2019, CLZhao 9528 (SWFC).

Distribution: Africa—Seychelles; Asia—China, India; North America—Jamaica, the United States; South America—Brazil; Oceania—Australia, New Zealand [64].

Hyphoderma moniliforme (P.H.B. Talbot) Manjón, G. Moreno and Hjortstam, in Hjortstam, Manjón and Moreno, Mycotaxon 33: 261 (1988).

Specimens examined: on the fallen branch of angiosperm, 9 January 2019, CLZhao 10176, CLZhao 10232, CLZhao 10242; 10 January 2019, CLZhao 10,386 (SWFC).

Distribution: Asia—China; Europe—Spain [64].

Hyphoderma mutatum (Peck) Donk, Fungus, Wageningen 27: 15 (1957).

Specimens examined: on the fallen branch of angiosperm, 9 January 2019, CLZhao 10019, CLZhao 10050, CLZhao 10104, CLZhao 10139, CLZhao 10141, CLZhao 10,203 (SWFC).

Distribution: Asia—China, Japan; Europe—Denmark, Finland, Norway, Sweden; North America—Canada, the United States [64].

Hyphoderma nudicephalum Gilb. And M. Blackw., Mycotaxon 33: 378 (1988).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3481 (SWFC).

Distribution: Asia—China, Japan, Korea; Europe—Denmark, Spain; Oceania—Australia, New Zealand [64].

Hyphoderma transiens (Bres.) Parmasto, Consp. System. Corticiac. (Tartu): 114 (1968)

Specimens examined: on the fallen branch of angiosperm, 6 January 2019, CLZhao 9628 (SWFC).

Distribution: Asia—China, Japan [64].

Irpex lacteus (Fr.) Fr., Elench. fung. (Greifswald) 1: 142 (1828) (Figure 6).

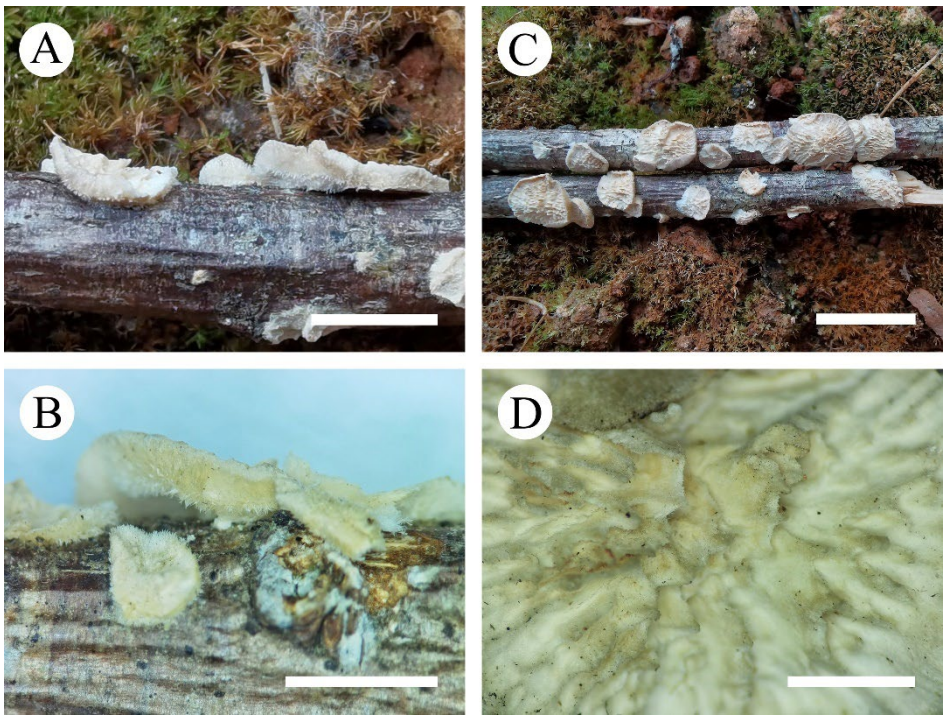


Figure 6. Basidiomata in situ of *Irpex lacteus*. (**A**,**B**) The front of the basidiomata; (**C**) the back of the basidiomata; (**D**) a section of hymenophore. Bars: A =C = 1 cm; B = D = 1 mm.

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4338, CLZhao 4365; 6 October 2017, CLZhao 4579; 4 January 2019, CLZhao 9438; 6 January 2019,

CLZhao 9765; 7 January 2019, CLZhao 9816, CLZhao 9824, CLZhao 9855, CLZhao 9883, CLZhao 9922; on the fallen branch of angiosperm, 6 October 2017, CLZhao 4609, CLZhao 4730, CLZhao 9398, CLZhao 9612, CLZhao 9728, CLZhao 9748; 7 January 2019, CLZhao 9878, CLZhao 9888, CLZhao 10,113 (SWFC).

Distribution: Asia—China, Japan; Europe—France, the United Kingdom; North America—the United States [64].

Junghuhnia crustacea (Jungh.) Ryvarden, Persoonia 7(1): 18 (1972).

Specimens examined: on the fallen branch of angiosperm, 2 October 2017, CLZhao 3588 (SWFC).

Distribution: Asia—China; North America—the United States; South America—Brazil [64].

Junghuhnia nitida (Pers.) Ryvarden, Persoonia 7(1): 18 (1972).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3650; 6 October 2017, CLZhao 4439, CLZhao 4455, CLZhao 4631; on the fallen branch of angiosperm, 2 October 2017, CLZhao 3474, CLZhao 3480; 5 October 2017, CLZhao 4219; 6 October 2017, CLZhao 4702; 5 January 2019, CLZhao 9447, CLZhao 9588; 6 January 2019, CLZhao 9667, CLZhao 9707; 7 January 2019, CLZhao 9854, CLZhao 9884, CLZhao 9919, CLZhao 9943, CLZhao 9969, CLZhao 9998; 9 January 2019, CLZhao 10082, CLZhao 10097, CLZhao 10178, CLZhao 10186, CLZhao 10211, CLZhao 10252, CLZhao 10271, CLZhao 10323; 10 January 2019, CLZhao 10350, CLZhao 10436, CLZhao 10458, CLZhao 10476, CLZhao 10497, CLZhao 10,535 (SWFC).

Distribution: Asia—China, Japan; Europe—France, the United Kingdom; North America—the United States [64].

Laxitextum incrustatum Hjortstam and Ryvarden, Mycotaxon 13(1): 35 (1981).

Specimens examined: on the trunk of angiosperm, 4 January 2019, CLZhao 9273 (SWFC).

Distribution: Africa—Tanzania, Ethiopia; Asia—China; North America—the United States; South America—Brazil [64].

Lenzites betulinus (L.) Fr. (as 'betulina'), Epicr. syst. mycol. (Upsaliae): 405 (1838).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4268, CLZhao 4281; 9 January 2019, CLZhao 10151; on the stump of angiosperm, 10 January 2019, CLZhao 10425, CLZhao 10454, CLZhao 10498, CLZhao 10,516 (SWFC).

Distribution: Asia—China, Japan, North Korea, Philippines; Europe—Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Netherlands, Norway, Russia, Slovenia, Spain, Sweden, the United Kingdom; North America—Canada, Mexico, the United States; South America—Brazil [64].

Lopharia ayresii (Berk. ex Cooke) Hjortstam, Mycotaxon 54: 188 (1995).

Specimens examined: on the trunk of angiosperm, 9 January 2019, CLZhao 10074, CLZhao 10,103 (SWFC).

Distribution: Africa—Angola, Eswatini, Kenya, Mauritius, South Africa, Tanzania, Uganda, Zimbabwe; Asia—China, Sri Lanka; North America—the United States; South America—Brazil, Ecuador; Oceania—Australia [64].

Lopharia mirabilis (Berk. and Broome) Pat., Bull. Soc. mycol. Fr. 11(1): 14 (1895).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3518, CLZhao 3519, CLZhao 3670; 6 October 2017, CLZhao 4399, CLZhao 4620; on the fallen branch of angiosperm, 4 January 2019, CLZhao 9376 (SWFC).

Distribution: Africa—Congo; Asia—China, India, Japan, Sri Lanka, Thailand; Europe—Russia [64].

Lyomyces bambusinus C.L. Zhao, in Chen and Zhao, MycoKeys 65: 105 (2020).

Specimens examined: on dead bamboo, 3 October 2017, CLZhao 3675; 11 January 2018, CLZhao 4808, CLZhao 4831, CLZhao 4840 (SWFC).

Distribution: Asia—China [64].

Lyomyces cremeus C.L. Zhao, in Chen and Zhao, MycoKeys 65: 108 (2020).

Specimens examined: on fallen branch of angiosperm, 21 August 2017, CLZhao 2812, CLZhao 4138; 23 August 2018, CLZhao 8295 (SWFC).

Distribution: Asia—China [64].

Lyomyces macrosporus C.L. Zhao, in Chen and Zhao, MycoKeys 65: 108 (2020).

Specimens examined: on the fallen branch of angiosperm, 6 October 2017, CLZhao 4516, CLZhao 4531 (SWFC).

Distribution: Asia—China [64].

Lyomyces wuliangshanensis C.L. Zhao, in Chen and Zhao, MycoKeys 65: 111 (2020).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4108, CLZhao 4144, CLZhao 4167; on fallen branch of angiosperm, 6 October 2017, CLZhao 4475; on the stump of angiosperm, 5 October 2017, CLZhao 4206 (SWFC).

Distribution: Asia—China [64].

Megasporia ellipsoidea (B.K. Cui and P. Du) B.K. Cui and Hai J. Li, in Li and Cui, Mycologia 105(2): 375 (2013).

Specimens examined: on the fallen branch of angiosperm, 10 January 2019, CLZhao 10,360 (SWFC).

Distribution: Asia—China [64].

Megasporia major (G.Y. Zheng and Z.S. Bi) B.K. Cui and Hai J. Li, in Li and Cui, Mycologia 105(2): 375 (2013).

Specimens examined: on the fallen branch of angiosperm, 10 January 2019, CLZhao 10,363 (SWFC).

Distribution: Asia—China [64].

Megasporoporiella pseudocavernulosa B.K. Cui and Hai J. Li, in Li and Cui, Mycologia 105(2): 378 (2013).

Specimens examined: on the fallen branch of angiosperm, 4 January 2019, CLZhao 9339; 6 January 2019, CLZhao 9593, CLZhao 9688, CLZhao 9750; 7 January 2019, CLZhao 9806; 9 January 2019, CLZhao 10196, CLZhao 10,308 (SWFC).

Distribution: Asia—China [64].

Megasporoporiella subcavernulosa B.K. Cui and Hai J. Li, in Li and Cui, Mycologia 105(2): 378 (2013).

Specimens examined: on the fallen branch of angiosperm, 6 October 2017, CLZhao 4442, CLZhao 4714 (SWFC).

Distribution: Asia—China [64].

Metuloidea murashkinskyi (Burt) Miettinen and Spirin, in Miettinen and Ryvarden, Ann. bot. fenn. 53(3-4): 165 (2016).

Specimens examined: on the trunk of angiosperm, 3 October 2017, CLZhao 3669, CLZhao 4454; on the fallen branch of angiosperm, 5 January 2019, CLZhao 9455 (SWFC).

Distribution: Asia—China, Japan; Europe—Bulgaria, Iran, Russia [64].

Microporus vernicipes (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 3(3): 497 (1898).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4311, CLZhao 4361; 6 October 2017, CLZhao 4419; on the fallen branch of angiosperm, 2 October 2017, CLZhao 3672 (SWFC).

Distribution: Africa—Kenya, Zambia; Asia—China, Japan, Vietnam [64].

Microporus xanthopus (Fr.) Kuntze, Revis. gen. pl. (Leipzig) 3(3): 494 (1898).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4280; 5 January 2019, CLZhao 9577; on the fallen branch of angiosperm, 1 October 2017, CLZhao 3419 (SWFC).

Distribution: Asia—China, Japan, Malaysia [64].

Neodatronia sinensis B.K. Cui, Hai J. Li and Y.C. Dai, in Li, Cui and Dai, Persoonia 32: 178 (2014).

Specimens examined: on the fallen branch of angiosperm, 5 January 2019, CLZhao 9471 (SWFC).

Distribution: Asia—China [64].

Nigroporus vinosus (Berk.) Murrill, Bull. Torrey bot. Club 32(7): 361 (1905).

Specimens examined: on the trunk of angiosperm, 1 October 2017, CLZhao 3393; on the fallen branch of angiosperm, 1 October 2017, CLZhao 3376 (SWFC).

Distribution: Africa—Mozambique, Niger, Syria; Asia—China, Japan, Saudi Arabia; Europe—Spain; North America—Cuba, Mexico, Panama, the United States; Oceania—Australia [64].

Oxychaete cervinogilva (Jungh.) Miettinen, in Miettinen, Spirin, Vlasák, Rivoire, Stenroos and Hibbett, MycoKeys 17: 20 (2016).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3462, CLZhao 3465, CLZhao 3482, CLZhao 3642, CLZhao 3657, CLZhao 3663 (SWFC).

Distribution: Asia—China; Oceania—Australia [64].

Peniophora cinerea (Pers.) Cooke, Grevillea 8 (no. 45): 20 (1879).

Specimens examined: on the fallen branch of angiosperm, 3 January 2019, CLZhao 9254 (SWFC).

Distribution: Asia—China, India, Japan, Turkey; Europe—Austria, Denmark, Estonia, Finland, France, Germany, Italy, Netherlands, Norway, Poland, Portugal, Russia, Sweden, Ukraine; North America—Canada, Cuba, Jamaica, Mexico, the United States; South America—Brazil; Oceania—Australia, New Zealand [64].

Peniophora incarnata (Pers.) P. Karst., Hedwigia 28: 27 (1889) (Figure 7).

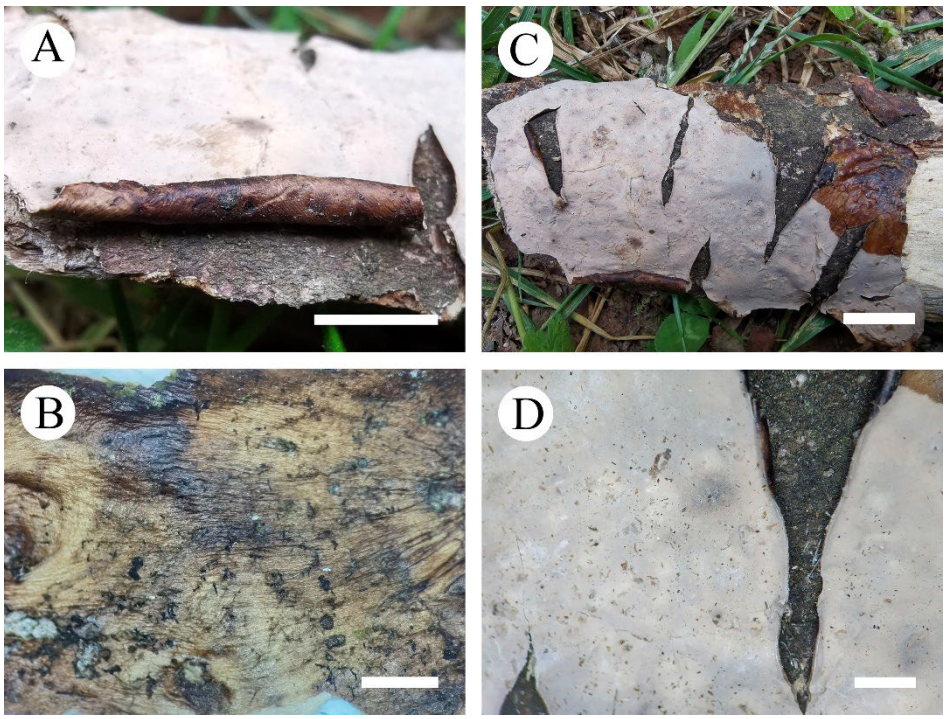


Figure 7. Basidiomata in situ of *Peniophora incarnata*. (**A**,**B**) The front of the basidiomata; (**C**) the back of the basidiomata; (**D**) a section of hymenophore. Bars: A = C = 1 cm; B = D = 2 mm.

Specimens examined: on the trunk of angiosperm, 7 January 2019, CLZhao 9859 (SWFC).

Distribution: Africa—Morocco; Asia—China, India, Iran, Japan; Europe—Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Russia, Sweden, Switzerland, the United Kingdom, Ukraine; North America—Canada, Mexico, the United States; South America—Brazil, Chile; Oceania—Australia, New Zealand [64].

Peniophora pseudoversicolor Boidin, Bull. mens. Soc. linn. Lyon 34: 162 (1965).

Specimens examined: on the fallen branch of angiosperm, 4 January 2019, CLZhao 9415 (SWFC).

Distribution: Asia—China, Turkmenistan; Europe—Belgium, Denmark, Estonia, France, Germany, Italy, Portugal, Spain; Oceania—Australia [64].

Peniophorella fissurata C.L. Zhao, in Guan, Zhao and Zhao, Mycol. Progr. 19(4): 400 (2020).

Specimens examined: on the fallen branch of angiosperm, 6 October 2017, CLZhao 4539; 4 January 2019, CLZhao 9421 (SWFC).

Distribution: Asia—China [64].

Peniophorella pubera (Fr.) P. Karst., Bidr. Känn. Finl. Nat. Folk 48: 427 (1889).

Specimens examined: on the fallen branch of angiosperm, 4 January 2019, CLZhao 9336, CLZhao 9405 (SWFC).

Distribution: Asia—China, Japan; Europe—Denmark, Finland, Norway, Sweden, North America—Canada, the United States [64].

Peniophorella rude (Bres.) K.H. Larss., Mycol. Res. 111(2): 192 (2007).

Specimens examined: on the fallen branch of angiosperm, 1 October 2017, CLZhao 3360; 5 October 2017, CLZhao 4086, CLZhao 4300; 7 January 2019, CLZhao 9862; 9 January 2019, CLZhao 10212; 10 January 2019, CLZhao 10,419 (SWFC).

Distribution: Asia—China, Japan; North America—the United States; South America—Brazil [64].

Perenniporia luteola B.K. Cui and C.L. Zhao, in Zhao and Cui, Mycoscience 54(3): 235 (2013).

Specimens examined: on the dead tree of angiosperm, 10 January 2019, CLZhao 10354; on the trunk of angiosperm, 10 January 2019, CLZhao 10334, CLZhao 10345, CLZhao 10403, CLZhao 10406, CLZhao 10411; on the fallen branch of angiosperm, 10 January 2019, CLZhao 10353, CLZhao 10355, CLZhao 10376, CLZhao 10384, CLZhao 10,393 (SWFC).

Distribution: Asia—China [64].

Perenniporia mopanshanensis C.L. Zhao, in Zhao and Ma, Mycotaxon 134(1): 132 (2019).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4677, CLZhao 4693; on the fallen branch of angiosperm, 6 October 2017, CLZhao 4708 (SWFC).

Distribution: Asia—China [64].

Phaeophlebiopsis peniophoroides (Gilb. and Adask.) Floudas and Hibbett, Fungal Biology 119(7): 710 (2015).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3637 (SWFC).

Distribution: Asia—China; North America—the United States; South America—Brazil [64].

Phanerochaete angustocystidiata Sheng H. Wu, Bot. Bull. Acad. sin., Taipei 41(2): 166 (2000)

Specimens examined: on the fallen branch of angiosperm, 4 January 2019, CLZhao 9280, CLZhao 9505 (SWFC).

Distribution: Asia—China [64].

Phanerochaete australis Jülich, in Jermy, J. Linn. Soc., Bot. 81(1): 43 (1980).

Specimens examined: on the stump of angiosperm, 2 October 2017, CLZhao 3571 (SWFC).

Distribution: Asia—China, Indonesia, Malaysia [64].

Phanerochaete concrescens Spirin and Volobuev, in Volobuev, Okun, Ordynets and Spirin, Mycol. Progr. 14(no. 80): 7 (2015).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4367; 5 January 2019, CLZhao 9585; 7 January 2019, CLZhao 9856, CLZhao 9899 (SWFC).

Distribution: Asia—China; Europe—Russia [64].

Phanerochaete sanguineocarnosa Floudas and Hibbett, Fungal Biology 119(7): 688 (2015).

Specimens examined: on the trunk of angiosperm, 6 September 2017, CLZhao 4447, CLZhao 4639, CLZhao 4691 (SWFC).

Distribution: Asia—China; North America—the United States [64].

Phanerochaete sordida (P. Karst.) J. Erikss. and Ryvarden, in Eriksson, Hjortstam and Ryvarden, Cortic. N. Eur., 5 (Oslo): 1023 (1978).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4238, CLZhao 4270; 9 January 2019, CLZhao 10290; 10 January 2019, CLZhao 10347; on the fallen branch of angiosperm, 1 October 2017, CLZhao 3407; 5 October 2017, CLZhao 4082, CLZhao 4084, CLZhao 4091; 5 January 2019, CLZhao 9460; 7 January 2019, CLZhao 9936, CLZhao 9983; 9 January 2019, CLZhao 10172, CLZhao 10213, CLZhao 10314; 10 January 2019, CLZhao 10337, CLZhao 10366, CLZhao 10378, CLZhao 10390, CLZhao 10392, CLZhao 10402, CLZhao 10413, CLZhao 10439, CLZhao 10466, CLZhao 10518; on the fallen branch of *Pinus*, 5 October 2017, CLZhao 4087, CLZhao 4094, CLZhao 4134, CLZhao 4140, CLZhao 4187, CLZhao 4360 (SWFC).

Distribution: Asia—China, Iran, Japan, Nepal, Thailand; Europe—Denmark, Finland, Sweden; North America—Canada, the United States; Oceania—Australia [64].

Phlebiopsis castanea (Lloyd) Miettinen and Spirin, in Miettinen, Spirin, Vlasák, Rivoire, Stenroos and Hibbett, MycoKeys 17: 25 (2016).

Specimens examined: on the fallen branch of angiosperm, 2 October 2017, CLZhao 3501 (SWFC).

Distribution: Asia—China, Japan, South Korea, Thailand; Europe—Russia [64].

Phlebiopsis crassa (Lév.) Floudas and Hibbett, Fungal Biology 119(7): 710 (2015) (Figure 8).

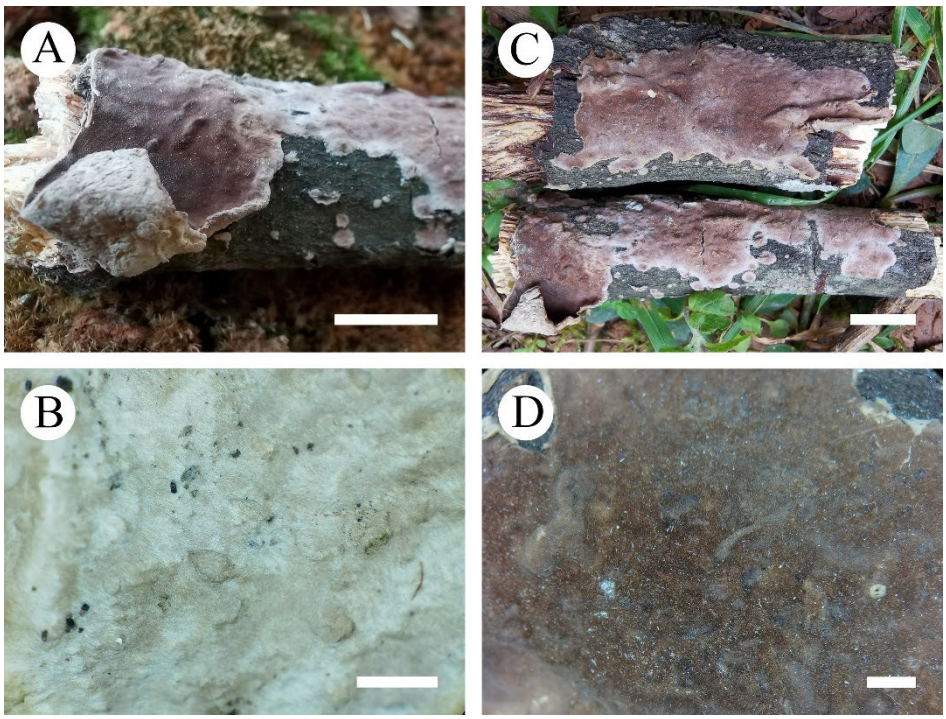


Figure 8. Basidiomata in situ of *Phlebiopsis crassa*. (**A**,**B**) The front of the basidiomata; (**C**) the back of the basidiomata; (**D**) a section of hymenophore. Bars: A = C = 1 cm; B = 1 mm; D = 2 mm.

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4128; 7 January 2019, CLZhao 9817; on the fallen branch of angiosperm, 1 October 2017, CLZhao 3339, 5 October 2017, CLZhao 4123, CLZhao 4172, CLZhao 4194, CLZhao 4225; 6 October 2017, CLZhao 4640; 4 January 2019, CLZhao 9316; 5 January 2019, CLZhao 9458, CLZhao 9539; 7 January 2019, CLZhao 9801, CLZhao 9827, CLZhao 9838 (SWFC).

Distribution: Asia—China, Vietnam; Europe—Belgium; North America—the United States; Oceania—Australia [64].

Pycnoporus sanguineus (L.) Murrill, Bull. Torrey bot. Club 31(8): 421 (1904).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4129, CLZhao 4234 (SWFC).

Distribution: Asia—China; Europe—France; North America—the United States; Oceania—Australia [64].

Rhomboidia wuliangshanensis C.L. Zhao, in Xu, Liu, Chen and Zhao, Mycotaxon 134(4): 656 (2020).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4406, CLZhao 4411 (SWFC).

Distribution: Asia—China [64].

Rigidoporus pouzarii Vampola and Vlasák, Czech Mycol. 64(1): 5 (2012).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4524 (SWFC).

Distribution: Asia—China; Europe—Germany, Ukraine; North America—the United States [64].

Serpula dendrocalami C.L. Zhao, in Wang, Das, Bera, Chen, Bhatt, Ghosh, Hembrom, Hofstetter, Parihar, Vizzini, Xu, Zhao and Buyck, Cryptog. Mycol. 40(5): 88 (2019).

Specimens examined: on the dead bamboo, 2 October 2017, CLZhao 3521, CLZhao 3607, CLZhao 3626, CLZhao 3632 (SWFC).

Distribution: Asia—China [64].

Sistotrema brinkmannii (Bres.) J. Erikss., K. Fysiogr. Sällsk. Lund. Förhandl. 18(no. 8): 134 (1948).

Specimens examined: on the trunk of angiosperm, 4 January 2019, CLZhao 9324, CLZhao 9344, CLZhao 9347 (SWFC).

Distribution: Asia—China; Europe—Bulgaria, Denmark, France, Germany, Italy, Poland, Portugal, Romania, Russia, Spain, the United Kingdom; North America—the United States; South America—Brazil [64].

Sistotremastrum guttuliferum Melo, M. Dueñas, Tellería and M.P. Martín, in Telleria, Melo, Dueñas, Salcedo, Beltrán-Tejera, Rodríguez-Armas and Martín, Mycol. Progr. 12(3): 688 (2012).

Specimens examined: on the trunk of angiosperm, 6 January 2019, CLZhao 9771; on the fallen branch of angiosperm, 5 January 2019, CLZhao 9454 (SWFC).

Distribution: Asia—China, South Korea; Europe—Romania, Spain [64].

Steccherinum bourdotii Saliba and A. David, Cryptog. Mycol. 9(2): 100 (1988).

Specimens examined: on the stump of angiosperm, 13 January 2018, CLZhao 4297; 10 January 2019, CLZhao 10,340 (SWFC).

Distribution: Asia—China, India; Europe—Belgium, Czech Republic, France, Germany, Russia, Switzerland [64].

Steccherinum confragosum Maas Geest. and Lanq., Persoonia 8(2): 149 (1975).

Specimens examined: on the fallen branch of angiosperm, 5 October 2017, CLZhao 4347 (SWFC).

Distribution: Asia—China; Europe—Belarus, France [64].

Steccherinum ochraceum (Pers. ex J.F. Gmel.) Gray, Nat. Arr. Brit. Pl. (London) 1: 651 (1821).

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4523; 4 January 2019, CLZhao 9290; on the fallen branch of angiosperm, 7 January 2019, CLZhao 9953; 9 January 2019, CLZhao 10,055 (SWFC).

Distribution: Asia—China, Japan; Europe—Denmark, Germany, Norway, Spain, Sweden; North America—the United States; Oceania—Australia [64].

Terana coerulea (Lam.) Kuntze, Revis. gen. pl. (Leipzig) 2: 872 (1891).

Specimens examined: on the fallen branch of angiosperm, 6 January 2019, CLZhao 9613; 7 January 2019, CLZhao 9803, CLZhao 9812 (SWFC).

Distribution: Asia—China, Turkey; Europe—Belgium, Croatia, Czech Republic, Denmark, France, Germany, Greece, Italy, Macedonia, Portugal, Slovenia, Spain, Sweden, Switzerland, the United Kingdom, Ukraine [64].

Tinctoporellus epimiltinus (Berk. and Broome) Ryvarden, Trans. Br. mycol. Soc. 73(1): 18 (1979).

Specimens examined: on the trunk of angiosperm, 2 October 2017, CLZhao 3605 (SWFC).

Distribution: Asia—China, Japan, Malaysia; Europe—the United Kingdom; North America—Mexico [64].

Trametes ellipsospora Ryvarden, Mycotaxon 28(2): 539 (1987).

Specimens examined: on the fallen branch of angiosperm, 3 October 2017, CLZhao 3774 (SWFC).

Distribution: Asia—China; North America—the United States [64].

Trametes hirsuta (Wulfen) Lloyd, Mycol. Writ. (Cincinnati) 7(Letter 73): 1319 (1924)

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4278, CLZhao 4279, CLZhao 4342; on the fallen branch of angiosperm, 5 October 2017, CLZhao 4070, CLZhao 4170; 7 January 2019, CLZhao 9912, CLZhao 9986; on the stump of angiosperm, 2 October 2017, CLZhao 3572; on the fallen branch of *Pinus*, 5 October 2017, CLZhao 4295 (SWFC).

Distribution: Asia—China, India; Europe—Poland, the United Kingdom [64].

Trametes pavonia (Berk.) Fr., Nova Acta R. Soc. Scient. upsal., Ser. 3 1(1): 98 (1851).

Specimens examined: on the fallen branch of angiosperm, 2 October 2017, CLZhao 3740 (SWFC).

Distribution: Asia—China; North America—the United States; South America—Argentina, Brazil [64].

Trametes versicolor (L.) Lloyd, Mycol. Notes (Cincinnati) 65: 1045 (1921) (Figure 9).

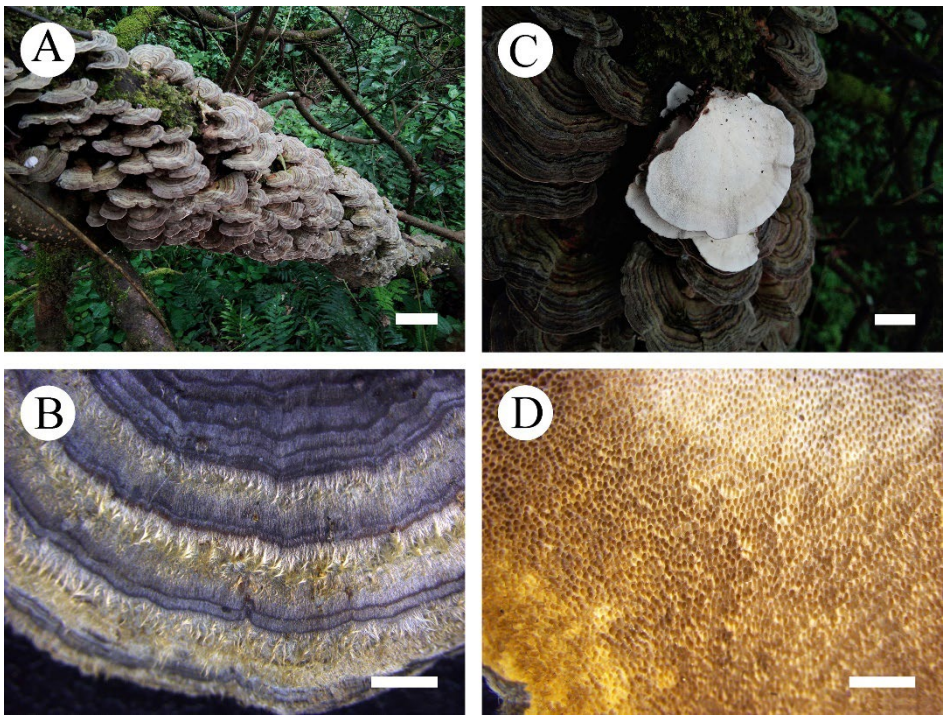


Figure 9. Basidiomata in situ of insulare. (**A**,**B**) The front of the basidiomata; (**C**) the back of the basidiomata; (**D**) a section of hymenophore. Bars: A = 4 cm; B = D = 2 mm; C = 1 cm.

Specimens examined: on the trunk of angiosperm, 6 October 2017, CLZhao 4451, CLZhao 4497, CLZhao 4627; 5 January 2019, CLZhao 9587; 9 January 2019, CLZhao 10090; on the fallen branch of angiosperm, 6 October 2017, CLZhao 4487 (SWFC).

Distribution: Asia—China, India, Japan; Europe—Belgium, Denmark, Finland, France, Germany, Greece, Italy, Norway, Poland, Portugal, Spain, Sweden, the United Kingdom; North America—the United States [64].

Trametopsis cervina (Schwein.) Tomšovský, Czech Mycol. 60(1): 7 (2008).

Specimens examined: on the fallen branch of angiosperm, 5 January 2019, CLZhao 9449, CLZhao 9493 (SWFC).

Distribution: Africa—Morocco; Asia—China, India; Europe—Germany, the United Kingdom [64].

Trechispora nivea (Pers.) K.H. Larss., Symb. bot. upsal. 30(no. 3): 110 (1995).

Specimens examined: on the trunk of angiosperm, 9 January 2019, CLZhao 10154, CLZhao 10297; 10 January 2019, CLZhao 10373, CLZhao10389, CLZhao 10398, CLZhao 10,442 (SWFC).

Distribution: Asia—China; Europe—Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, Norway, Poland, Romania, Russia, Spain, Sweden, Switzerland, the United Kingdom [64].

Truncospora ochroleuca (Berk.) Pilát, Sb. Nár. Mus. v Praze, Rada B, Prír. Vedy 9(2): 108 (1953).

Specimens examined: on the trunk of angiosperm, 5 October 2017, CLZhao 4350; on the stump of angiosperm, 4 January 2019, CLZhao 9328 (SWFC).

Distribution: Africa—Ethiopia, Kenya, Malawi, Tanzania; Asia—China, India, Japan, Malaysia, Singapore, Sri Lanka, Vietnam; Europe—Finland, France, Russia; North America—Mexico, the United States; South America—Brazil; Oceania—Australia, New Zealand [64].

4. Discussion

Both phyla Ascomycota and Basidiomycota cover around 97% of all fungal species in the kingdom fungi [65]. On the basis of the latest version of Ainsworth and Bisby's *Dictionary of the Fungi* [66], 1589 genera and more than 30 thousand species of Basidiomycota were included, and many taxa were recorded all over the world every year, which observably increase the fungal diversity [7,67–74]. The wood-decaying fungi have been extensively studied in China [6,7,68,72,73,75–78], but the diversity of wood-decaying fungi in the Wuliangshan area is yet elusive. The present paper is the first report of a series of studies devoted to wood-decaying fungi in this area and contributes to reveal abundance of wood-decaying species. A total of 2454 specimens belonging to 95 wood-decaying poroid and corticioid species were collected from the Wuliangshan area and identified based on morphological studies and phylogenetic analysis. According to the previous studies [6,16,63] combined with field observations, five species (5.26% of the total), *Dacryobolus angiospermarum*, *Fibroporia albicans*, *Gloeophyllum sepiarium*, *Hymenochaete berteroi*, and *Serpula dendrocalami* can cause a brown rot; the remaining 90 species (94.74% of the total) cause a white rot. In contrast, the proportion of brown-rot fungus in the Wuliangshan area is similar to that in the Haikou Forestry Farm which is 6.12% [78], but lower than Huangshan Mountains, Laojun Mountains and Great Xingan Mountains at 14.12%, 25% and 26.19%, respectively [75–77].

Although some remarkable explorations of wood-decaying fungi have been made from the Yunnan Province [57,68,79–89], only nine new species, *Rhomboidia wuliangshanensis*, *Gloeodontia yunnanensis*, *Lyomyces bambusinus*, *L. cremeus*, *L. macrosporus*, *L. wuliangshanensis*, *Peniophorella fissurata*, *Perenniporia mopanshanensis* and *Serpula dendrocalami* were found from the Wuliangshan area [85,86,90–93]. Species in the present list are mostly new to the studied area. All collected specimens were confirmed to be 95 species, which are distributed in 59 genera, 23 families, and 9 orders (Table 2). Of these 95 species listed, 67 species belong to the order Polyporales, accounting for 70.53%, indicating that polypores are the dominant group in this area; 12 species belong to the order Russulales; 6 species belong to the Hymenochaetales; 3 species belong to the Auriculariales; 2 species belong to Boletales and Trechisporales, and 1 species belongs to Cantharellales, Corticiales and

Gloeophyllales. The present study indicates that *Aleurodiscus botryosus*, *A. cerussatus*, *A. mirabilis*, *Asterostroma muscicola*, *Auricularia cornea*, *A. delicata*, *Bjerkandera adusta*, *Byssomerulius corium*, *Daedaleopsis confragosa*, *Datronia stereoides*, *Fomes fomentarius*, *Hydnoporia corrugata*, *Lenzites betulinus*, *Lopharia ayresii*, *Nigroporus vinosus*, *Peniophora cinerea*, *P. incarnata*, *Sistotrema brinkmannii*, *Steccherinum ochraceum*, *Terana coerulea*, *Trametes versicolor*, *Trechispora nivea and Truncospora ochroleuca* species are common, *Abundisporus quercicola*, *Aleurodiscus isabellinus*, *Gloeodontia yunnanensis*, *Lyomyces bambusinus*, *L. cremeus*, *L. macrosporus*, *L. wuliangshanensis*, *Megasporoporiella pseudocavernulosa*, *Peniophorella fissurata*, *Perenniporia luteola*, *P. mopanshanensis*, *Phanerochaete angustocystidiata*, *Rhomboidia wuliangshanensis* and *Serpula dendrocalami* are rare worldwide according to the distribution, whereas 69 species belong to rare native species (fewer than five specimens followed previous study [6]); 49 species are distributed in Eurasia, and 61 are spread in the Northern Hemisphere; *Bjerkandera adusta* and *Fomes fomentarius* could function as indicators that detect heavy metal biosorption; *Bjerkandera adusta*, *Daedaleopsis confragosa*, *Datronia stereoides*, *Fomes fomentarius* and *Peniophora incarnata* are expansive, and *Cerrena albocinnamomea*, *Heterobasidion insulare*, *Phanerochaete concrescens* and *Phlebiopsis castanea* are invasive in the Wuliangshan area. In addition, the underlying fungal diversity in the Wuliangshan area is unpredictable, and a more intensive investigation is needed to complement the further biodiversity.

Table 2. Number of wood-inhabiting poroid and corticioid species in the most representative orders, families, and genera in the study area and proportion accounting for total species number.

Orders					**Families**				**Genera**		
Order	**Family**	**Genera**	**Spp.**	**%**	**Family**	**Genera**	**Spp.**	**%**	**Genera**	**Spp.**	**%**
Polyporales	9	40	67	70.53	Polyporaceae	18	28	29.47	*Aleurodiscus*	5	5.26
Russulales	5	6	12	12.63	Phanerochaetaceae	6	11	11.58	*Phanerochaete*	5	5.26
Hymenochaetales	2	3	6	6.32	Steccherinaceae	5	8	8.42	*Hyphoderma,*	4	4.21
Auriculariales	1	1	3	3.16	Hyphodermataceae	2	8	8.42	*Lyomyces*	4	4.21
Boletales	2	4	2	2.11	Stereaceae	2	6	6.32	*Trametes*	4	4.21
Trechisporales	1	2	2	2.11	Irpicaceae	5	5	5.26	*Auricularia*	3	3.16
Cantharellales	1	1	1	1.05	Cerrenaceae	2	3	3.16	*Peniophora*	3	3.16
Corticiales	1	1	1	1.05	Hymenochaetaceae	2	3	3.16	*Peniophorella*	3	3.16
Gloeophyllales	1	1	1	1.05	Rickenellaceae	1	3	3.16	*Steccherinum*	3	3.16
					Subtotal	43	75	78.95	Subtotal	34	35.79
					Other families (14)	16	20	21.05	Other genera (50)	61	64.21
Total	**23**	**59**	**95**	**100%**	**23**	**59**	**95**	**100%**	**59**	**95**	**100%**

As an essential component of the forest ecosystems, most of the wood-inhabiting poroid and corticioid fungi function as wood decomposers that release matter and energy to the ecological system [94–96]. Herein, we further found 2 edible fungi, *Auricularia cornea* and *A. delicata*, according to Dai et al. [97], together with 14 medicinal fungi, *Bjerkandera adusta*, *Cerrena zonata*, *Daedaleopsis confragosa*, *Earliella scabrosa*, *Fomes fomentarius*, *Ganoderma australe*, *Gloeophyllum sepiarium*, *Hexagonia tenuis*, *Irpex lacteus*, *Lenzites betulinus*, *Lopharia ayresii*, *Pycnoporus sanguineus*, *Trametes hirsuta* and *T. versicolor*, according to Dai and Yang [98]. Some notable medical fungi were found, such as *Bjerkandera adusta*, a potential antineoplastic agent [99], as well as *Trametes hirsute,* which possesses the effect of curing rheumatism and relieving cough [100,101]. In addition, an industrial white-rot fungus was also found in this study. As a target of interest, *Trametes versicolor* was conducted under a free or immobilized laccase condition exploring its biocatalytic characterization in the activation zone [102]. Moreover, though these saprophytic species possess powerful enzymes, which can effectively degrade lignocellulose [103], *Abundisporus quercicola*,

Bjerkandera adusta, *Ceriporia lacerata*, *Cerrena zonata*, *C. albocinnamomea*, *Daedaleopsis confragosa*, *Fomes fomentarius* and *Gyrodontium sacchari* are treated as forest pathogens contrarily [104].

Phylogenetically, based on a study of the molecular systematics on the subphyla Agaricomycotina, Pucciniomycotina and Ustilaginomycotina with combined nLSU, SSU, 5.8s, rpb1, rpb2, and tef1 datasets, He et al. [105] revealed 1928 currently used genera names, which are distributed in 241 families, 68 orders, 18 classes and 4 subphyla. In the present study, 95 species nested in 59 genera, 23 families, and 9 orders based on the ITS dataset, which is similar to the previous studied topology [105], were revealed. Sequences of ITS gene regions of the studied samples were generated, which illustrates that all collected fungal specimens from the Wuliangshan area belonging to Agaricomycetes distribute into Auriculariales, Boletales, Cantharellales, Corticiales, Gloeophyllales, Hymenochaetales, Polyporales, Russulales and Trechisporales (Figure 1). Phylogenetic analyses of all studied samples shows that the individual taxon clusters closely with the downloaded reliable sequence from previous studies with a supported rate (Figure 2).

Based on the early embrace of molecular systematics by mycologists, both the discovery and classification of fungi among the more basal branches of the tree are now coming to light from genomic analyses and environmental DNA surveys [1]. Several comprehensively remarkable collections of wood-decaying fungi in China have been performed based on the combination of morphological features and molecular evidence; Dai illustrated 80 pathogenic wood-decaying fungi in 2005, which mainly belong to Ganodermataceae, Climacodontaceae, Corticiaceae, Hericiaceae, Hymenochataceae, Polyporaceae, and Schizophyllaceae of Basidiomycota [106]. In addition, Dai reported 140 wood-decaying fungi on stored wood or structural timber in 2009, and 29 are brown-rot and 111 are white-rot fungus [107]. The fungal diversity from the Hainan area in China showed that it includes 240 species, of which 199 are polypores, and 41 are corticoid and other wood-inhabiting fungi [108]. In addition, this place is located at the longitude and latitude of 108°37′–111°03′ E and 18°10′–20°10′ N. The Atlas of Chinese Macrofungal Resources revealed that it has 1819 species belonging to 509 genera. According to their morphological characteristics, they are divided into 10 groups, including 196 larger Ascomycetes, 21 jelly fungi, 47 coral fungi, 637 polyporoid, hydnaceous and thelephoroid fungi, 11 cantharelloid fungi, 653 agarics, 130 boletes, 75 gasteroid fungi, 16 larger pathogenic fungi on crops, and 33 larger Myxomycetes [109]. The book of Atlas of Macrofungi in Saihanwula National Nature Reserve of Inner Mongolia indicated that it includes 310 species, located in 3 phyla, 8 classes, 24 orders, 66 families, 152 genera [110]; its longitude and latitude are 118°18′–118°55′ E and 43°59′–44°27′ N. The result shows that the tropical and subtropical areas have enriched fungal diversity, which supports our research regarding to the richness of wood-decaying fungi in China.

In the last 20 years, dramatic changes in higher-level taxonomy have occurred, as evidenced by a tripling of fungal phyla from 4 to 12. The hidden and microscopic nature of many fungi also means that their biodiversity is undersampled, in which perhaps less than 5% of the estimated two to four million species have been formally described [2,16,111]. The present work will comprehensively improve the understanding of the diversity of wood-decaying fungi in this area, in which 29 species are new for China, i.e., *Aleurodiscus botryosus*, *Aleurodiscus isabellinus*, *Auricularia asiatica*, *Crustodontia chrysocreas*, *Flavodon ambrosius*, *Gloeodontia yunnanensis*, *Hyphoderma moniliforme*, *Hyphoderma nudicephalum*, *Hyphoderma transiens*, *Laxitextum incrustatum*, *Lyomyces bambusinus*, *Lyomyces cremeus*, *Lyomyces macrosporus*, *Lyomyces wuliangshanensis*, *Peniophora pseudoversicolor*, *Peniophorella fissurata*, *Peniophorella pubera*, *Peniophorella rude*, *Perenniporia mopanshanensis*, *Phaeophlebiopsis peniophoroides*, *Phanerochaete concrescens*, *Phanerochaete sanguineocarnosa*, *Rhomboidia wuliangshanensis*, *Rigidoporus pouzarii*, *Serpula dendrocalami*, *Sistotremastrum guttuliferum*, *Steccherinum bourdotii*, *Steccherinum confragosum* and *Terana coerulea.* The research region of wood-inhabiting fungi in the Wuliangshan area covers 2,581 square kilometres, accounting for 0.65% of the area of the Yunnan Province and for 0.027% of China. This work

is conducive to the rational utilization and effective protection of fungal resources, and provides scientific basis for the prevention and control of forest diseases in this area.

Author Contributions: Conceptualization, C.-L.Z.; methodology, C.-L.Z. and X.H.; software, C.-L.Z. and X.H.; validation, C.-L.Z. and X.H.; formal analysis, C.-L.Z. and X.H.; investigation, C.-L.Z. and X.H.; resources, C.-L.Z.; writing—original draft preparation, C.-L.Z. and X.H.; writing—review and editing, C.-L.Z. and X.H.; visualization, C.-L.Z. and X.H.; supervision, C.-L.Z.; project administration, C.-L.Z.; funding acquisition, C.-L.Z. All authors have read and agreed to the published version of the manuscript.

Funding: The research was supported by the National Natural Science Foundation of China (Project No. 32170004, U2102220), Yunnan Fundamental Research Project (Grant No. 202001AS070043) and High-level Talents Program of Yunnan Province (YNQR-QNRC-2018-111).

Institutional Review Board Statement: Not applicable for studies involving humans or animals.

Informed Consent Statement: Not applicable for studies involving humans.

Data Availability Statement: Publicly available datasets were analyzed in this study. This data can be found here: https://www.ncbi.nlm.nih.gov/; https://www.mycobank.org/page/Simple%20names%20search; http://purl.org/phylo/treebase, submission ID 29040; accessed on 23 November 2021.

Conflicts of Interest: The authors declare no conflicts of interest.

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