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蓝小菇

Mycena galericulata (Scop.) Gray

属于担子菌门Basidiomycota，蘑菇纲Agaricomycetes，蘑菇目Agaricales，小菇科Mycenaceae。湖南师范大学陈作红教授2022年7月29日摄于湖南省八大公山国家级自然保护区。

研究论文

简报

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Mycena galericulata (Scop.) Gray
Basidiomycota, Agaricomycetes, Agaricales, Mycenaceae. Courtesy of Prof. CHEN Zuohong, Hunan Normal University, taken from Badagongshan National Nature Reserve, Hunan, 29 July 2022.

Research papers

Short communication

Research paper 研究论文

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云南省文山地区木腐菌真菌资源多样性研究

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摘　要：本研究于 2017–2021 年在云南省文山地区进行了 5 次实地调查，共采集木腐真菌标本 2 923 号。采用经典分类学方法开展了该地区采集标本的准确鉴定，并编制了木腐真菌完整名录。采用最大似然法、最大简约法和贝叶斯推理法对研究标本的ITS nrRNA基因序列构建系统发育树，剖析分类单元的聚类关系及物种间的系统发育关系。研究结果揭示该地区共报道木腐真菌 104 种，隶属于 5 目 18 科 55 属。其中多孔菌目为优势目(占总数的 51.92%)，多孔菌科为优势科(占总数的 24.04%)，木齿菌属为优势属(占总数的 12.50%)。

关键词：担子菌门；生物资源；多样性；分子系统学；文山地区

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Diversity of wood-decaying fungi in Wenshan Area, Yunnan Province, China

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Abstract: Five field surveys were carried out in Wenshan area, Yunnan Province, China during 2017–2021, and 2 923 specimens of wood-decaying fungi were collected. A checklist of wood-decaying fungi with their hosts and substrates is given. The taxa were identified in the light of their morphology and molecular evidence. The sequences of ITS nrRNA gene region of the studied specimens were generated and the phylogenetic analyses were performed with the maximum likelihood, maximum parsimony and Bayesian inference methods. The paper summarizes the obtained results of investigation on the wood-decaying fungi of this area,

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consisting of 104 species belonging to 55 genera, 18 families and 5 orders. Polyporales is the dominant order (51.92% of the total orders found in this area), and Polyporaceae is the dominant family (24.04% of the total) and *Xylodon* is the dominant genus (12.50% of the total).
Keywords: Basidiomycota; biological resources; diversity; molecular systematics; Wenshan

INTRODUCTION

Fungi are a diverse, monophyletic group of eukaryotes and these organisms show immense ecological and economic impacts for playing an important role in the ecosystems as diverse as soil, trees, hidden layers within their substrate (James *et al*. 2020). Approximately 150 thousand species of fungi have been described (Dai *et al*. 2021; Wang & Zhao 2021), but the potential biodiversity of the group is likely to be 2.2–3.8 millions of species (Blackwell 2011; Taylor *et al*. 2014; Hibbett 2016; Hawksworth & Lücking 2017). The diversity for flora of seed plants in Yunnan Province is higher than that in other areas of China. The number of discovered new fungal species totalled 1 345 from this province from 2000 to 2020. Endemic woody plants are rich in Yunnan, supplying rich and varied substrates for wood-decaying fungi. Wood-decaying fungi with industrial, medicinal, edible and economic value, comprise most basidiomycetes and ascomycetes growing on various kinds of living trees, dead and fallen trunk, fallen branch and stump (Russell & Paterson 2006; Dai 2012a; Dai *et al*. 2015, 2021; Vinay *et al*. 2015; Wu *et al*. 2019, 2020; M'Barek *et al*. 2020; Runnel *et al*. 2021; Luo *et al*. 2022), displaying a considerable ability to degrade plant remains and different environmental contaminants through their extensive organic compound degradation abilities (James *et al*. 2020).

The Wenshan area is located in the southeast part of Yunnan Province, including Laojunshan National Nature Reserve and Xiaoqiaogou National Nature Reserve and their surrounding areas (Yang *et al*. 2008). The geographical location is between 103°48′–104°52′ E and 23°16′–22°29′ N with the altitude of 1 200–2 991 m; the average annual precipitation is more than 1 500 mm (Yang *et al*. 2008; Li *et al*. 2021). The plant resources are rich, with 187 families, 946 genera and 3 085 species of seed plants (Yang *et al*. 2008). The vegetation types varied with elevation differences (Yang *et al*. 2008; Li *et al*. 2021). The Wenshan area has five main types of well-preserved vegetation namely the mid-mountain wet, semi-wet evergreen broad-leaved forest, monsoon evergreen broad-leaved forest, mossy evergreen broad-leaved forest and mossy dwarf forest (Yang *et al*. 2008), which are precondition of the fungal diversity of this area.

Most of wood-decaying fungi are reported in northwest Yunnan, and some polypore and the corticioid fungi have been reported in the southeast of the Yunnan Province (Xie 1992; Chen 1994; Zhang *et al*. 2012; Guo *et al*. 2013; Dai *et al*. 2014; Chen *et al*. 2020; Wang & Zhao 2021). 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 (Dai 2012a; Dai *et al*. 2015, 2021; Wu *et al*. 2020). The current wood-decaying fungal catalogues include the poroid and corticioid hymenophores. In the present study, five field trips were carried out in Wenshan area, and 104 species were identified. This work aims at providing an updated checklist of wood-decaying fungi in Wenshan, as well as enriching the knowledge of the fungal diversity of China.

1 MATERIALS AND METHODS

1.1 Sample collection and herbarium specimen preparation

The fresh fruiting bodies of basidiomycetous macrofungi growing on angiosperm stumps, trunks and branches were collected in 5 sampling points (approximately the four corners of the square and centre) within 1×1 km^2 for 2–3 times every year in Wenshan area from 2017–2021. Three basidiomata

at least are required and each individual is up to 3 cm long, 2 cm wide, in which the smallest fruiting structure has to include the hymenophore. The samples were photographed *in situ* and its fresh macroscopic details were recorded. Photographs were recorded by a Jianeng 80D camera. All the photos were focus stacked and merged using Helicon Focus software. The samples were transported to a field station where the fruit bodies were dried on an electronic food dryer (Fsfruit) at 45 °C for 48 hours. Then the dried specimens were sealed in an envelope and zip-lock plastic bags and labeled. The dried specimens were deposited in the herbarium of Southwest Forestry University (SWFC), Kunming, Yunnan Province, China.

1.2 Morphological studies

The macromorphological descriptions were based on field notes. The color terms are from those of Petersen (1996). The micromorphological data were obtained from the dried specimens and observed under a light microscope following Dai (2012a). The following abbreviations were used for the micro-characteristics' description: 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.

1.3 Molecular procedures and phylogenetic analysis

CTAB rapid plant genome extraction kit-DN14 (Aidlab Biotechnologies Co., Ltd) 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 (White *et al*. 1990). 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.) and directly sequenced at Kunming Tsingke Biological Technology Limited Company. All of the newly generated sequences were deposited at GenBank (Table 1).

Sequencher 4.6 (GeneCodes) was used to edit the DNA sequence. Sequences were aligned in MAFFT 7 (http://mafft. cbrc.jp/alignment/server/) using the "G-INS-i" strategy and manually adjusted in BioEdit (Hall 1999). Sequences from type materials of *Dacrymyces flabelliformis* Burds. & Laursen and *D*. *cyrtosporus* Shirouzu acquired from GenBank were utilized as another outgroup to root tree following James *et al*. (2020) in the ITS analysis (Fig. 1).

Maximum parsimony analysis was applied to the ITS dataset sequences. Approaches to phylogenetic analysis followed Zhao & Wu (2017) and the tree construction procedure was performed in PAUP* version 4.0b10 (Swofford 2002). All of the characters were equally weighted and gaps were treated as missing data. Trees were inferred using the heuristic search option with TBR branch swapping and 1 000 random sequence additions. Max-trees were set to 5 000, branches of zero length were collapsed and all parsimonious trees were saved. Clade robustness was assessed using a bootstrap (BT) analysis with 1 000 replicates (Felsenstein 1985). Descriptive tree statistics tree length (TL), the consistency index (CI), the retention index (RI), the rescaled consistency index (RC), and the 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 (Miller *et al*. 2012). Branch support (BS) for ML analysis was determined by 1 000 bootstrap replicates.

MrModeltest 2.3 (Nylander 2004) 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 (Ronquist & Huelsenbeck 2003). Four Markov chains were run for 2 runs from random starting trees for 9.8 million thousand

Table 1 A list of species, specimens, and GenBank accession numbers of sequences used in this study

Species name	Specimen No.	GenBank accession No.	References
		ITS	
Abundisporus fuscopurpureus	CLZhao 10707	MW742669	Present study
Abundisporus fuscopurpureus	Cui 8638	JN048771	Zhao *et al*. 2013
Auricularia cornea	CLZhao 10992	MW742652	Present study
Auricularia cornea	TFB 3470	JX065149	Looney *et al*. 2013
Auricularia delicata	CLZhao 11076	MW742674	Present study
Auricularia delicata	CNSBlitz 0098	JX065171	Looney *et al*. 2013
Auricularia villosula	CLZhao 11296	MW742676	Present study
Auricularia villosula	MFLU 162127	KX621163	Bandara *et al*. 2017
Bjerkandera adusta	CLZhao 10719	MW742575	Present study
Bjerkandera adusta	CX-9	KY706088	Bouacem *et al*. 2017
Brevicellicium olivascens	CLZhao 16223	MW582728	Present study
Brevicellicium olivascens	KHL 8571	JN649327	Sjökvist *et al*. 2012
Byssomerulius corium	CLZhao 11247	MW742584	Present study
Byssomerulius corium	FCUG 2701	MZ636931	Chen *et al*. 2021
Cerioporus mollis	CLZhao 12084	MW582729	Present study
Cerioporus mollis	WD794	AB587623	Sotome *et al*. 2011
Cerioporus scutellatus	CLZhao 12114	MW582730	Present study
Cerioporus scutellatus	WD 2272	LC412118	Sotome *et al*. 2019
Ceriporiopsis semisupina	CLZhao 17017	MW582738	Present study
Ceriporiopsis semisupina	Cui 11146	KU509525	Zhao 2012
Climacodon pulcherrimus	CLZhao 11238	MW742592	Present study
Climacodon pulcherrimus	CBS 130.40	MH856063	Vu *et al*. 2019
Coriolopsis sanguinaria	CLZhao 10773	MW742555	Present study
Coriolopsis sanguinaria	Cui 14507	MK192428	Ji *et al*. 2019
Dacryobolus montanus	CLZhao 16336	MW582749	Present study
Dacryobolus montanus	Yuan 5758	KC344412	Yuan *et al*. 2016
Dacrymyces cyrtosporus	PDD 107980	NR148190	He & Zhao 2022
Dacrymyces flabelliformis	PDD 76696	NR_166790	He & Zhao 2022
Daedaleopsis confragosa	CLZhao 17302	MW582750	Present study
Daedaleopsis confragosa	MOGU 148-19	OM422749	Cartabia *et al*. 2021
Datronia mollis	CLZhao 10927	MW742552	Present study
Datronia mollis	Dai 11253	JX559258	Li *et al*. 2014
Datronia stereoides	CLZhao 11227	MW742548	Present study
Datronia stereoides	Cui 8132	JX559270	Li *et al*. 2014
Dentocorticium bicolor	CLZhao 17117	MW582751	Present study
Dentocorticium bicolor	He 2757	MF626355	Liu *et al*. 2018
Dentocorticium ussuricum	CLZhao 16063	MW582752	Present study
Dentocorticium ussuricum	He 3322	MF626360	Liu *et al*. 2018
Efibula yunnanensis	CLZhao 11641	MT611529	Present study
Efibula yunnanensis	Wu 880515-1	MZ636977	Chen *et al*. 2021
Foraminispora yunnanensis	CLZhao 15955	MW582753	Present study
Foraminispora yunnanensis	Cui 7974	KJ531653	Li & Yuan 2015
Fulvoderma australe	CLZhao 10680	MW742566	Present study
Fulvoderma australe	Dai 11671	MF860771	Zhou *et al*. 2018
Fuscoporia subferrea	CLZhao 10733	MW742564	Present study
Fuscoporia subferrea	Dai 16327	KX961098	Chen & Yuan 2017

(to be continued)

(Table 1 continued)

Species name	Specimen No.	GenBank accession No.	References
		ITS	
Fuscoporia torulosa	CLZhao 12061	MW582757	Present study
Fuscoporia torulosa	JV 1405/2	KX961106	Chen & Yuan 2017
Ganoderma gibbosum	CLZhao 11324	MW742521	Present study
Ganoderma gibbosum	KUT 0805	AB733121	Sun *et al*. 2020
Ganoderma lingzhi	CLZhao 16116	MW582758	Present study
Ganoderma lingzhi	Dai 12574	KJ143908	Zhou *et al*. 2014
Gloeodontia yunnanensis	CLZhao 10504	MN908252	Present study
Gloeodontia yunnanensis	CLZhao 11058	MN908253	Present study
Hydnochaete tabacinoides	CLZhao 10804	MW742562	Present study
Hydnochaete tabacinoides	Cui 10428	JQ279604	He & Dai 2012
Hymenochaete innexa	CLZhao 12082	MW582760	Present study
Hymenochaete innexa	He 555	JQ279584	He & Dai 2012
Hymenochaete minor	CLZhao 11986	MW582761	Present study
Hymenochaete minor	He 936	JQ279556	He & Dai 2012
Hymenochaete muroiana	CLZhao 12080	MW582762	Present study
Hymenochaete muroiana	He 172	JQ279541	He & Dai 2012
Hymenochaete porioides	CLZhao 10685	MW742520	Present study
Hymenochaete porioides	Cui 8057	JQ279518	He & Dai 2012
Hymenochaete rheicolor	CLZhao 11186	MW742560	Present study
Hymenochaete rheicolor	Cui 8317	JQ279529	He & Dai 2012
Hymenochaete separabilis	CLZhao 11996	MW582764	Present study
Hymenochaete separabilis	He 267	JQ279573	He & Dai 2012
Hyphoderma moniliforme	CLZhao 17280	MW582765	Present study
Hyphoderma moniliforme	TNM F14735	KC928282	Yurchenko & Wu 2015
Hyphoderma nudicephalum	CLZhao 16801	MW582767	Present study
Hyphoderma nudicephalum	Wu 9508225	AJ534268	Nilsson *et al*. 2003
Hyphoderma subsetigerum	CLZhao 16499	MW582770	Present study
Hyphoderma subsetigerum	WU 9508-155	AJ534275	Nilsson *et al*. 2003
Hyphodontia pallidula	CLZhao 11983	MW582771	Present study
Hyphodontia pallidula	SFC 20180601-01	MK992821	Lupala *et al*. 2019
Hyphodontia subglobosa	CLZhao 16499	MW582770	Present study
Hyphodontia subglobosa	Wu 890805-2	KY081798	Riebesehl & Langer 2017
Hyphodontia tropica	CLZhao 10834	MW742641	Present study
Hyphodontia tropica	CU8-G6-ITS4_M11.ab1	MN752433	Alshammari & Stephenson 2018
Irpex lacteus	CLZhao 10931	MW742570	Present study
Irpex lacteus	CD 2	FJ744594	Xu *et al*. 2009
Laxitextum bicolor	CLZhao 10765	MW742677	Present study
Laxitextum bicolor	CBS 412.34	MH855587	Vu *et al*. 2019
Lopharia mirabilis	CLZhao 11167	MW742515	Present study
Lopharia mirabilis	Dai 13722	MF626346	Liu *et al*. 2018
Lyomyces crustosus	CLZhao 12151	MW578312	Present study
Lyomyces crustosus	UC 2022841	KP814310	Chen & Zhao 2020
Lyomyces microfasciculatus	CLZhao 16872	MW578325	Present study
Lyomyces microfasciculatus	TNM F 24757	JN129976	Chen & Zhao 2020
Lyomyces orientalis	CLZhao 16242	MW578331	Present study
Lyomyces orientalis	KAS-GEL 3376	DQ340325	Chen & Zhao 2020

(to be continued)

(Table 1 continued)

Species name	Specimen No.	GenBank accession No.	References
		ITS	
Lyomyces wuliangshanensis	CLZhao 16183	MW578337	Present study
Lyomyces wuliangshanensis	CLZhao 4475	MN945983	Chen & Zhao 2020
Megasporoporiella subcavernulosa	CLZhao 12005	MW582734	Present study
Megasporoporiella subcavernulosa	Dai 12423	JQ780384	Li & Cui 2013
Microporus vernicipes	CLZhao 10632	MW742522	Present study
Microporus vernicipes	KUC 11046	KJ714006	Jang *et al*. 2016
Microporus xanthopus	CLZhao 10946	MW742529	Present study
Microporus xanthopus	KA 038	MK975984	Nguyen *et al*. 2019
Neodatronia gaoligongensis	CLZhao16765	MW578338	Present study
Neodatronia gaoligongensis	Cui 8055	JX559269	Li *et al*. 2014
Peniophora cinerea	CLZhao 11292	MW742675	Present study
Peniophora cinerea	CBS 261.37	MH855905	Vu *et al*. 2019
Peniophorella fissurata	CLZhao 11412	MN864261	Present study
Peniophorella fissurata	CLZhao 9421	MN864260	Guan *et al*. 2020
Peniophorella praetermissa	CLZhao 16977	MW578339	Present study
Peniophorella praetermissa	NH 9815	DQ647454	Guan *et al*. 2020
Peniophorella rude	CLZhao 11231	MW742666	Present study
Peniophorella rude	Wu 9307-39	DQ647499	Guan *et al*. 2020
Perenniporiopsis minutissima	CLZhao 16380	MW578342	Present study
Perenniporiopsis minutissima	Dai 11643	HQ876602	Zhao & Cui 2012
Perenniporiopsis concrescens	CLZhao 10805	MW742583	Present study
Perenniporiopsis concrescens	Spirin 6111	KP994352	Volobuev *et al*. 2015
Perenniporiopsis sordida	CLZhao 17153	MW578356	Present study
Perenniporiopsis sordida	FD-241	KP135136	Floudas & Hibbett 2015
Phellinus gilvus	CLZhao 12135	MW581164	Present study
Phellinus gilvus	MQN016	AB811862	Bang *et al*. 2014
Phlebia acerina	CLZhao 16763	MW581168	Present study
Phlebia acerina	FD-301	KP135378	Justo *et al*. 2017
Phlebia ailaoshanensis	CLZhao 16987	MW581175	Present study
Phlebia ailaoshanensis	CLZhao 4036	MH784927	Shen *et al*. 2018
Phlebiopsis crassa	CLZhao 10755	MW742613	Present study
Phlebiopsis crassa	KKN-86	KP135394	Floudas & Hibbett 2015
Postia caesia	CLZhao 16937	MW581197	Present study
Postia caesia	K(M) 31967	AY599567	Yao *et al*. 2005
Postia glauca	CLZhao 10833	MW742586	Present study
Postia glauca	X1339	MG137079	Miettinen *et al*. 2018
Pyrrhoderma adamantinum	CLZhao11306	MW742519	Present study
Pyrrhoderma adamantinum	Dai 17593	MF860792	Zhou *et al*. 2018
Scytinostroma yunnanense	CLZhao 10758	MT611445	Present study
Scytinostroma yunnanense	CLZhao 10802	MT611446	Present study
Skeletocutis diluta	CLZhao 11968	MW581199	Present study
Skeletocutis diluta	JV 061016K	JF692197	Vlasák *et al*. 2012
Skeletocutis kuehneri	CLZhao 11198	MW742653	Present study
Skeletocutis kuehneri	X 3324	MF685361	Miettinen & Niemelä 2018
Steccherinum ochraceum	CLZhao 16289	MW581200	Present study
Steccherinum ochraceum	KHL 11902	JN710590	Dong *et al*. 2022

(to be continued)

(Table 1 continued)

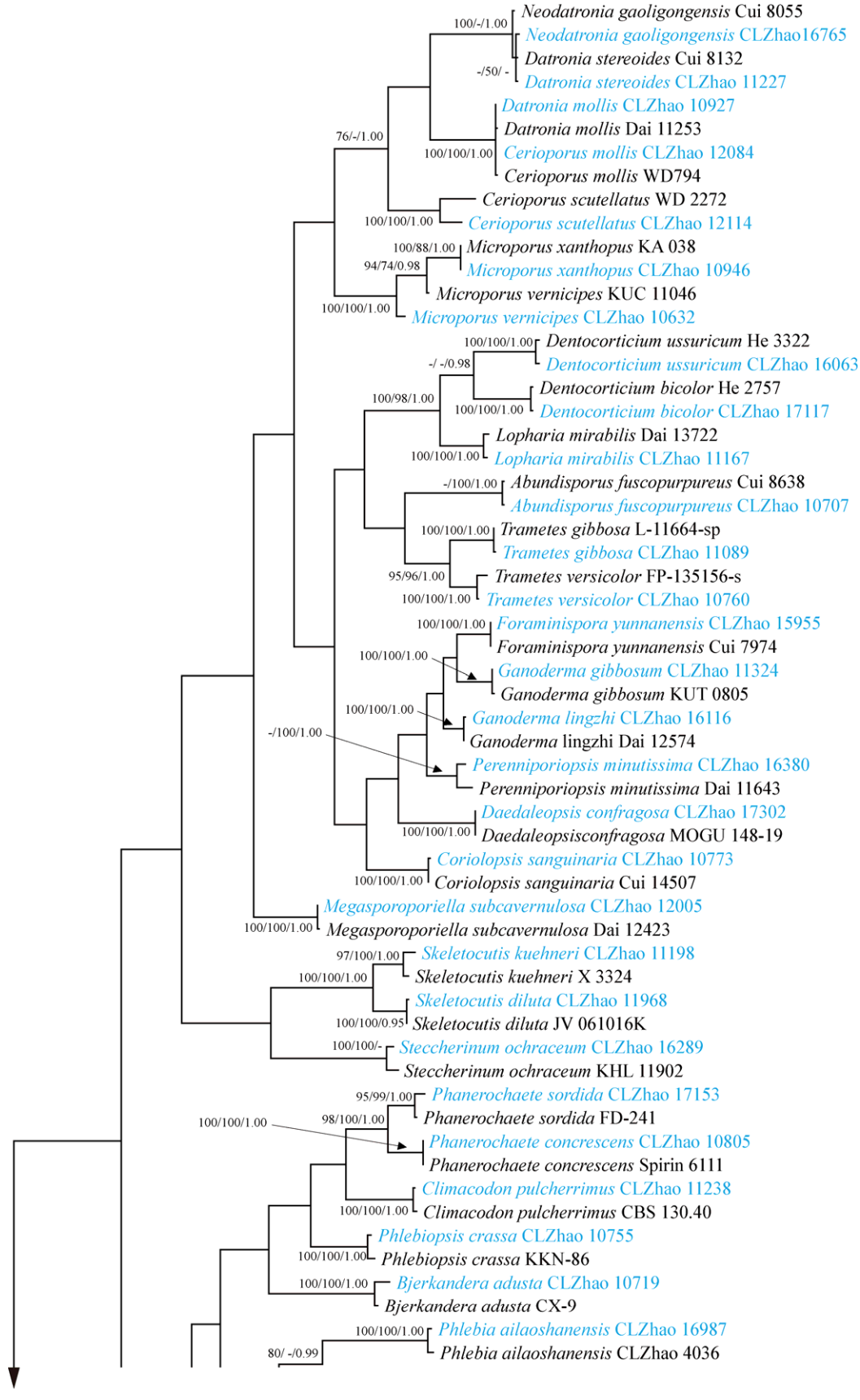
Species name	Specimen No.	GenBank accession No.	References
		ITS	
Trametes gibbosa	CLZhao 11089	MW742546	Present study
Trametes gibbosa	L-11664-sp	JN164943	Justo *et al*. 2017
Trametes versicolor	CLZhao 10760	MW742530	Present study
Trametes versicolor	FP-135156-sp	JN164919	Justo *et al*. 2017
Trechispora nivea	CLZhao 16478	MW581205	Present study
Trechispora nivea	EP.20-A1683	MT458536	Polemis *et al*. 2020
Trichaptum biforme	CLZhao 10652	MW742514	Present study
Trichaptum biforme	CBS 842.95	MH862562	Vu *et al*. 2019
Xenasmatella tenuis	CLZhao 11258	MT832959	Present study
Xenasmatella tenuis	CLZhao 4528	MT832960	Zhao & Cui 2013
Xylodon bubalinus	CLZhao 16006	MW581207	Present study
Xylodon bubalinus	Cui 6834	KY290981	Wang & Chen 2017
Xylodon flavipora	CLZhao 10988	MW742632	Present study
Xylodon flavipora	CFMR:DLL 2011-134	KJ140637	Brazee *et al*. 2014
Xylodon heterocystidiatus	CLZhao 15557	MW742678	Present study
Xylodon heterocystidiatus	Wu 9209-27	JX175045	Chen *et al*. 2017
Xylodon kunmingensis	CLZhao 17170	MW566128	Present study
Xylodon kunmingensis	CLZhao 3019	MK404532	Shi *et al*. 2019
Xylodon nespori	CLZhao 16090	MW566132	Present study
Xylodon nespori	Nordon 030915	DQ873622	Larsson *et al*. 2006
Xylodon niemelaei	CLZhao 16357	MW566133	Present study
Xylodon niemelaei	GC 1508-146	KX857798	Chen *et al*. 2017
Xylodon reticulatus	CLZhao 17077	MW566135	Present study
Xylodon reticulatus	GC 1512-1	KX857808	Chen *et al*. 2017
Xylodon serpentiformis	CLZhao 16115	MW566142	Present study
Xylodon serpentiformis	TUB-FO 40675	MH880228	Riebesehl *et al*. 2019
Xylodon subtropicus	CLZhao 16523	MW566144	Present study
Xylodon subtropicus	Wu 1508-2	KX857806	Chen *et al*. 2017
Xylodon taiwanianus	CLZhao 15928	MW566145	Present study
Xylodon taiwanianus	CBS 125875	MH864080	Vu *et al*. 2019

generations (Fig. 1) and trees were sampled every 100 generations. The first one-fourth generations were discarded as burn-ins. A majority rule consensus tree of all remaining trees was calculated. A majority rule consensus tree of all remaining trees was calculated. Branches were considered as significantly supported if they received a maximum likelihood bootstrap (BS) of >70%, a maximum parsimony bootstrap (BT) of >50%, or Bayesian posterior probabilities (BPP) of >0.95.

2 RESULTS

2.1 Molecular Phylogeny

The ITS dataset (Fig. 1) included sequences from 168 fungal specimens representing 85 species. The dataset had an aligned length of 1 100 characters, of which 329 characters were constant, 60 parsimony-uninformative, and 711 parsimony-informative. The maximum parsimony analysis yielded 30 equally parsimonious tree (TL=7 253, CI=0.232 2, HI=0.767 8, RI=0.716 1, RC=0.166 3). The best-fit model for ITS alignment estimated and applied in the Bayesian was GTR+I+G, lset nst=6, rates= invgamma; prset statefreqpr=dirichlet (1,1,1,1). The Bayesian and ML analyses showed a similar topology to that of the MP analysis with split frequencies=0.008 988 (BI), and the effective sample size (ESS) across the two runs is the double of the average ESS (avg ESS)=247.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Neodatronia gaoligongensis CLZhao16765
-/50/ -
Datronia stereoides Cui 8132
Datronia stereoides CLZhao 11227
Datronia mollis CLZhao 10927
76/-/1.00
Datronia mollis Dai 11253
100/100/1.00
Cerioporus mollis CLZhao 12084
Cerioporus mollis WD794
Cerioporus scutellatus WD 2272
100/100/1.00
Cerioporus scutellatus CLZhao 12114
100/88/1.00
Microporus xanthopus KA 038
94/74/0.98
Microporus xanthopus CLZhao 10946
Microporus vernicipes KUC 11046
100/100/1.00
Microporus vernicipes CLZhao 10632
100/100/1.00
Dentocorticium ussuricum He 3322
-/ -/0.98
Dentocorticium ussuricum CLZhao 16063
Dentocorticium bicolor He 2757
100/98/1.00
100/100/1.00
Dentocorticium bicolor CLZhao 17117
Lopharia mirabilis Dai 13722
100/100/1.00
Lopharia mirabilis CLZhao 11167
-/100/1.00
Abundisporus fuscopurpureus Cui 8638
Abundisporus fuscopurpureus CLZhao 10707
100/100/1.00
Trametes gibbosa L-11664-sp
Trametes gibbosa CLZhao 11089
95/96/1.00
Trametes versicolor FP-135156-s
100/100/1.00
Trametes versicolor CLZhao 10760
100/100/1.00
Foraminispora yunnanensis CLZhao 15955
Foraminispora yunnanensis Cui 7974
100/100/1.00
Ganoderma gibbosum CLZhao 11324
Ganoderma gibbosum KUT 0805
100/100/1.00
Ganoderma lingzhi CLZhao 16116
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Ganoderma lingzhi Dai 12574
Perenniporiopsis minutissima CLZhao 16380
Perenniporiopsis minutissima Dai 11643
Daedaleopsis confragosa CLZhao 17302
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Daedaleopsisconfragosa MOGU 148-19
Coriolopsis sanguinaria CLZhao 10773
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Coriolopsis sanguinaria Cui 14507
Megasporoporiella subcavernulosa CLZhao 12005
100/100/1.00
Megasporoporiella subcavernulosa Dai 12423
97/100/1.00
Skeletocutis kuehneri CLZhao 11198
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Skeletocutis kuehneri X 3324
Skeletocutis diluta CLZhao 11968
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Skeletocutis diluta JV 061016K
100/100/-
Steccherinum ochraceum CLZhao 16289
Steccherinum ochraceum KHL 11902
95/99/1.00
Phanerochaete sordida CLZhao 17153
100/100/1.00
98/100/1.00
Phanerochaete sordida FD-241
Phanerochaete concrescens CLZhao 10805
Phanerochaete concrescens Spirin 6111
Climacodon pulcherrimus CLZhao 11238
100/100/1.00
Climacodon pulcherrimus CBS 130.40
Phlebiopsis crassa CLZhao 10755
100/100/1.00
Phlebiopsis crassa KKN-86
100/100/1.00
Bjerkandera adusta CLZhao 10719
Bjerkandera adusta CX-9
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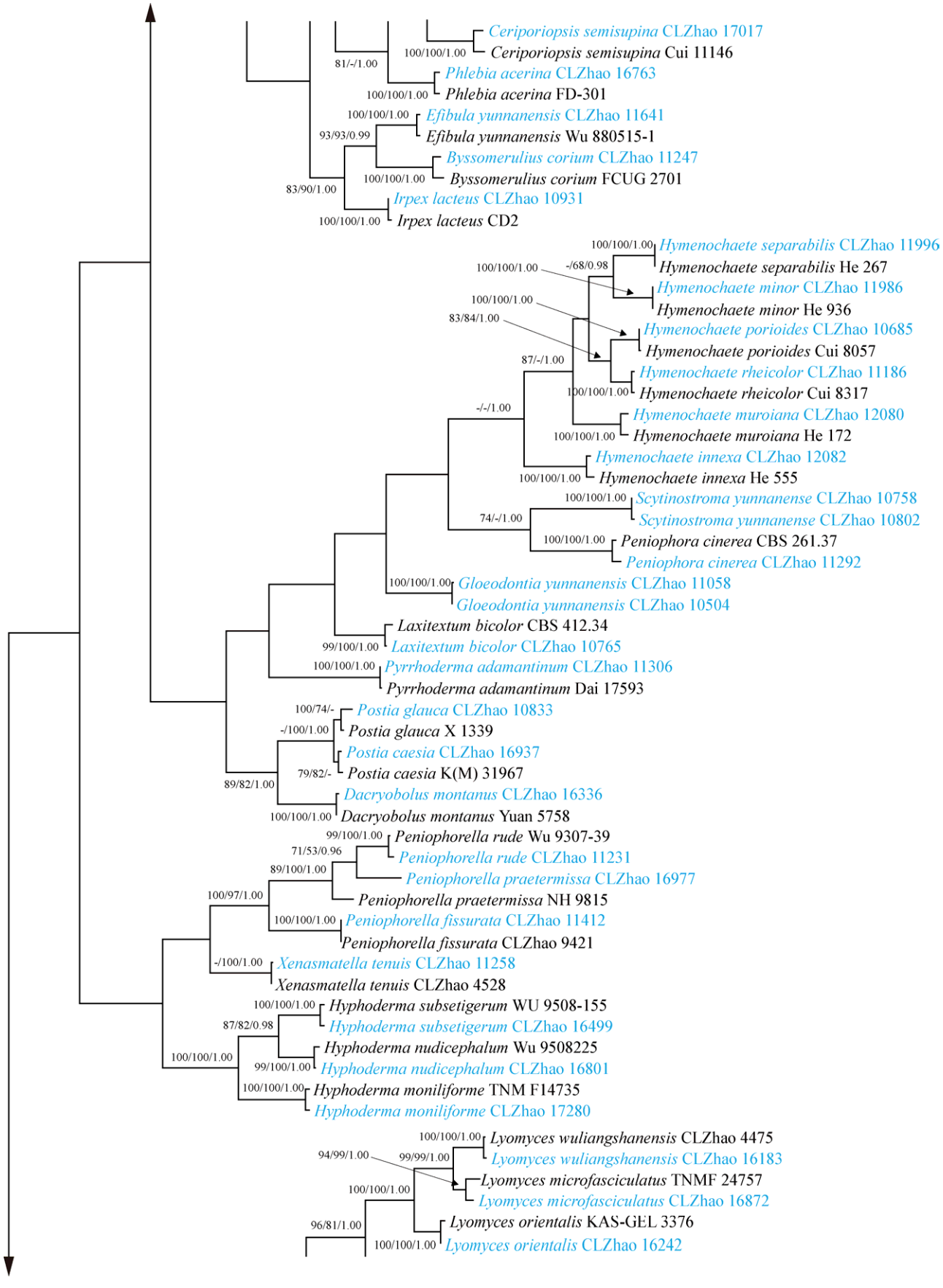
Phlebia ailaoshanensis CLZhao 16987
80/ -/0.99
Phlebia ailaoshanensis CLZhao 4036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93/93/0.99 *Efibula yunnanensis* Wu 880515-1
Byssomerulius corium CLZhao 11247
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83/90/1.00
Irpex lacteus CLZhao 10931
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100/100/1.00 *Hymenochaete separabilis* CLZhao 11996
100/100/1.00 -/68/0.98 *Hymenochaete separabilis* He 267
Hymenochaete minor CLZhao 11986
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Hymenochaete porioides Cui 8057
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Hymenochaete rheicolor CLZhao 11186
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Hymenochaete muroiana CLZhao 12080
100/100/1.00 *Hymenochaete muroiana* He 172
Hymenochaete innexa CLZhao 12082
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100/100/1.00 *Scytinostroma yunnanense* CLZhao 10758
74/-/1.00 *Scytinostroma yunnanense* CLZhao 10802
100/100/1.00 *Peniophora cinerea* CBS 261.37
Peniophora cinerea CLZhao 11292
100/100/1.00 *Gloeodontia yunnanensis* CLZhao 11058
Gloeodontia yunnanensis CLZhao 10504
Laxitextum bicolor CBS 412.34
99/100/1.00 *Laxitextum bicolor* CLZhao 10765
100/100/1.00 *Pyrrhoderma adamantinum* CLZhao 11306
Pyrrhoderma adamantinum Dai 17593
100/74/- *Postia glauca* CLZhao 10833
-/100/1.00 *Postia glauca* X 1339
Postia caesia CLZhao 16937
79/82/- *Postia caesia* K(M) 31967
89/82/1.00
Dacryobolus montanus CLZhao 16336
100/100/1.00 *Dacryobolus montanus* Yuan 5758
99/100/1.00 *Peniophorella rude* Wu 9307-39
71/53/0.96 *Peniophorella rude* CLZhao 11231
89/100/1.00 *Peniophorella praetermissa* CLZhao 16977
100/97/1.00 *Peniophorella praetermissa* NH 9815
100/100/1.00 *Peniophorella fissurata* CLZhao 11412
Peniophorella fissurata CLZhao 9421
-/100/1.00 *Xenasmatella tenuis* CLZhao 11258
Xenasmatella tenuis CLZhao 4528
100/100/1.00 *Hyphoderma subsetigerum* WU 9508-155
87/82/0.98 *Hyphoderma subsetigerum* CLZhao 16499
Hyphoderma nudicephalum Wu 9508225
100/100/1.00
99/100/1.00 *Hyphoderma nudicephalum* CLZhao 16801
100/100/1.00 *Hyphoderma moniliforme* TNM F14735
Hyphoderma moniliforme CLZhao 17280
100/100/1.00 *Lyomyces wuliangshanensis* CLZhao 4475
94/99/1.00 99/99/1.00 *Lyomyces wuliangshanensis* CLZhao 16183
Lyomyces microfasciculatus TNMF 24757
100/100/1.00
Lyomyces microfasciculatus CLZhao 16872
96/81/1.00 *Lyomyces orientalis* KAS-GEL 3376
100/100/1.00 *Lyomyces orientalis* CLZhao 16242

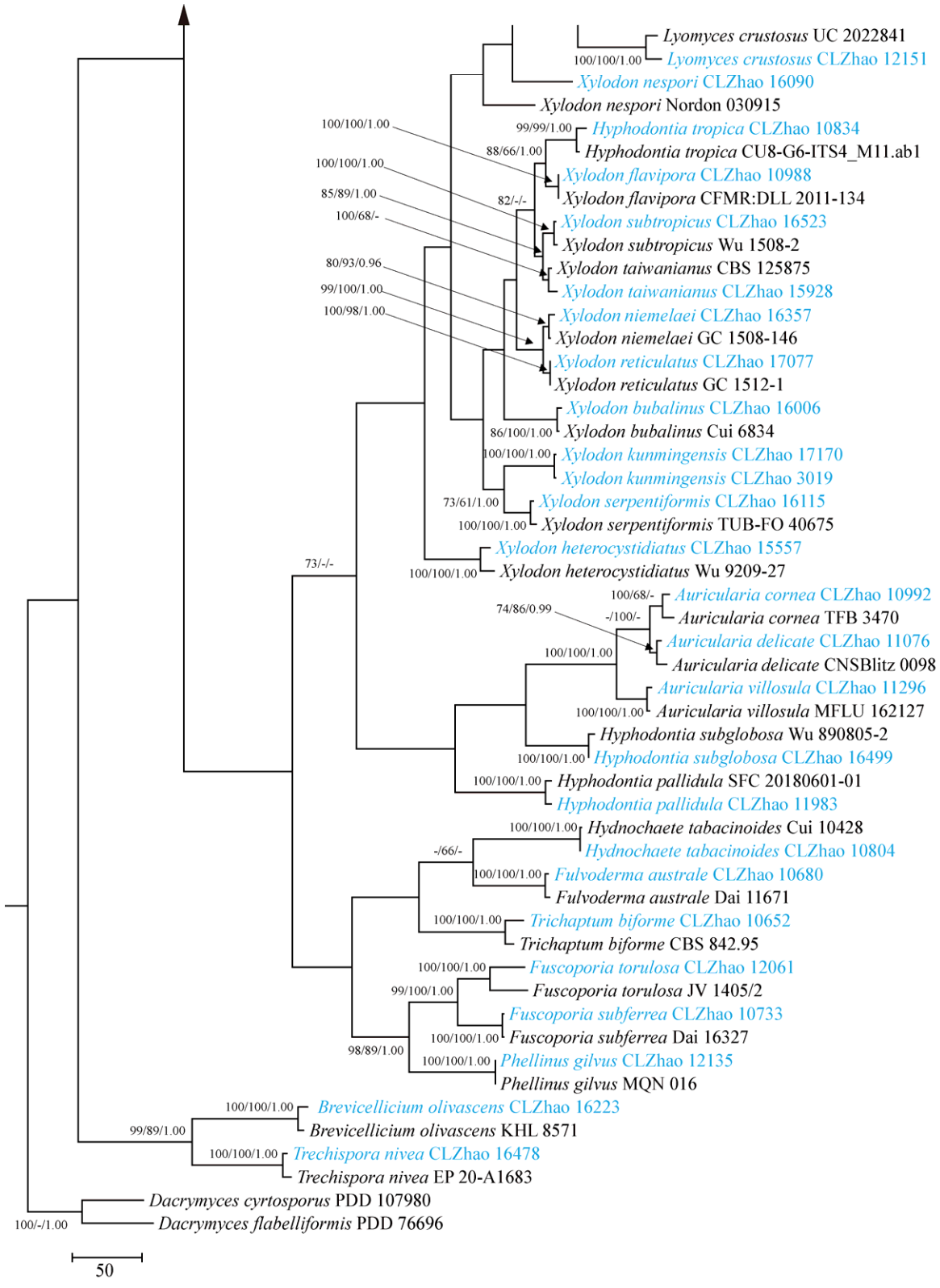

Fig. 1 Maximum parsimony strict consensus tree illustrating the phylogeny of 85 species in Agaricomycetes based on ITS sequences. Branches are labelled with a maximum likelihood boot-strap >70%, a parsimony bootstrap >50% and Bayesian posterior probabilities >0.97, respectively. The sequences of collections labelled in black are downloaded from GenBank, while those in blue are generated in this study.

2.2 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 21 April 2022). 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 following order: living tree, dead standing tree, trunk, fallen branch and stump. The collectors and collection numbers are listed alphabetically as well (Dai 2011, 2012a).

Abundisporus fuscopurpureus (Pers.) Ryvarden, Belg. Jl Bot. 131(2): 154 (1999)

Specimens examined: the stump of angiosperm, 14 January 2019, CLZhao 10707, 10783 (SWFC).

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

Specimens examined: the fallen branch of angiosperm, 7 July 2019, CLZhao 15559, 15599 (SWFC).

Antrodiella zonata (Berk.) Ryvarden, Boletín de la Sociedad Argentina de Botánica 28: 228 (1992)

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10744; 15 January 2019, CLZhao 10891, 10901, 10907, 10925, 10970, 10998, 11039, 11064, 11081, 11131; 23 January 2019, CLZhao 12003, 12010, 12059; the fallen branch of angiosperm, 23 January 2019, CLZhao 12012, 25 July 2019, CLZhao 16127; 26 July 2019, CLZhao 16425, 16442; the stump of angiosperm, 14 January 2019, CLZhao 10701, 25 July 2019, CLZhao 16219; the stump of *Pinus yunnanensis* Franch., 28 July 2019, CLZhao 17137 (SWFC).

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

Specimens examined: the trunk of angiosperm, 15 January 2019, CLZhao 10922 (SWFC).

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

Specimens examined: the trunk of angiosperm, 15 January 2019, CLZhao 10897, 10972, 11001, 11076 (SWFC).

Auricularia villosula Malysheva, in Malysheva & Bulakh, Nov. sist. Niz. Rast. 48: 174 (2014)

Specimens examined: the fallen branch of angiosperm, 16 January 2019, CLZhao 11296 (SWFC).

Bjerkandera adusta (Willd.) P. Karst., Meddelanden af Societas pro Fauna et Flora Fennica 5: 38 (1879)

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10634, 10719, 10747, 10825; 15 January 2019, CLZhao 10893, 10914, 10942; 23 January 2019, CLZhao 12046; the fallen branch of angiosperm, 14 January 2019, CLZhao 10826; 23 January 2019, CLZhao 12013; 26 July 2019, CLZhao 16340, 16551; the dead branch of angiosperm, 23 January 2019, CLZhao 11997, 12054, 12057, 12064, 12100, 12122, 12142, 12149, 12154; the stump of angiosperm, 15 January 2019, CLZhao 10917; 28 July 2019, CLZhao 17266 (SWFC).

Bjerkandera atroalba (Rick) Westph. & Tomšovský, Mycol. Progr. 14(no. 100): 3 (2015)

Specimens examined: the trunk of angiosperm, 15 January 2019, CLZhao 10954, 10968 (SWFC).

Brevicellicium olivascens (Bres.) K.H. Larss. & Hjortstam, Mycotaxon 7(1): 119 (1978)

Specimens examined: the fallen branch of angiosperm, 25 July 2019, CLZhao 16223 (SWFC).

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

Specimens examined: the fallen branch of angiosperm, 16 January 2019, CLZhao 11247, 11302 (SWFC).

Cerioporus mollis (Sommerf.) Zmitr. & Kovalenko, International Journal of Medicinal Mushrooms 18(1): 33 (2016)

Specimens examined: the trunk of angiosperm, 23 January 2019, CLZhao 12084 (SWFC).

Cerioporus scutellatus (Schwein.) Zmitr., Folia Cryptogamica Petropolitana 6: 47 (2018)

Specimens examined: the fallen branch of angiosperm, 23 January 2019, CLZhao 12114 (SWFC).

Ceriporiopsis semisupina C.L. Zhao, B.K. Cui & Y.C. Dai, Phytotaxa 164: 23 (2014)

Specimens examined: the stump of *Pinus yunnanensis* Franch., 28 July 2019, CLZhao 17148, 17161, 17168; the stump of *Picea asperata* Mast., 28 July 2019, CLZhao 17017, 17209 (SWFC).

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

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10621, 11190, 11202, 11233, 11238 (SWFC).

Coriolopsis sanguinaria (Klotzsch) Teng, Chung-kuo Ti Chen-chun, [Fungi of China]: 760 (1963)

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10646, 10672, 10773; 7 July 2019, CLZhao 15594 (SWFC).

Dacryobolus karstenii (Bres.) Oberw. ex Parmasto, Consp. System. Corticiac. (Tartu): 98 (1968)

Specimens examined: the fallen branch of angiosperm, 14 January 2019, CLZhao 10828 (SWFC).

Dacryobolus montanus X.Z. Wan & H.S. Yuan, Phytotaxa 265(2): 107 (2016)

Specimens examined: the fallen branch of angiosperm, 26 July 2019, CLZhao 16336 (SWFC).

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

Specimens examined: the stump of angiosperm, 28 July 2019, CLZhao 17302 (SWFC).

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

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10927 (SWFC).

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

Specimens examined: the fallen branch of angiosperm, 16 January 2019, CLZhao 11196, 11227, 11256, 11266, 11318 (SWFC).

Dentocorticium bicolor (P.H.B. Talbot) Nakasone & S.H. He, MycoKeys 32: 42 (2018)

Specimens examined: the fallen branch of angiosperm, 24 July 2019, CLZhao 16061; 28 July 2019, CLZhao 17117 (SWFC).

Dentocorticium ussuricum (Parmasto) M.J. Larsen & Gilb., Norwegian Journal of Botany 21: 226 (1974)

Specimens examined: the fallen branch of angiosperm, 24 July 2019, CLZhao 16063 (SWFC).

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

Specimens examined: the stump of angiosperm, 7 July 2019, CLZhao 15645, 15646, 15648, 15650, 15652, 15654 (SWFC).

Efibula yunnanensis C.L. Zhao, in Ma, Shi & Zhao, Phytotaxa 451: 242 (2020)

Specimens examined: the fallen branch of angiosperm, 19 January 2019, CLZhao 11641, 11637 (SWFC).

Fibrodontia alba Yurchenko & Sheng H. Wu, Mycoscience 55: 339 (2014)

Specimens examined: the fallen branch of angiosperm, 27 July 2019, CLZhao 16776; 28 July 2019, CLZhao 17032 (SWFC).

Foraminispora yunnanensis (J.D. Zhao & X.Q. Zhang) Y.F. Sun & B.K. Cui, Persoonia 44: 220 (2020)

Specimens examined: the ground, 23 July 2019, CLZhao 15955 (SWFC).

Fulvoderma australe L.W. Zhou & Y.C. Dai, Mycologia 110(5): 876 (2018)

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10680, 10703, 10722, 10800, 10815 (SWFC).

Fuscoporia subferrea Q. Chen & Yuan Yuan, Mycosphere 8(6): 1241 (2017)

Specimens examined: the trunk of angiosperm, 28 July 2019, CLZhao 17086; the

fallen branch of angiosperm, 14 January 2019, CLZhao 10733, 10798; 28 July 2019, CLZhao 16961, 17010, 17024, 17219 (SWFC).

Fuscoporia torulosa (Pers.) T. Wagner & M. Fisch., Mycological Research 105(7): 780 (2001)

Specimens examined: the stump of angiosperm, 23 January 2019, CLZhao 12061 (SWFC).

Ganoderma australe (Fr.) Pat., Bulletin de la Société Mycologique de France 5: 71 (1889)

Specimens examined: the living tree of *Cinnamomum bodinieri* Levl., 25 July 2019, CLZhao 16132; the stump of *Phoebe zhennan*, 24 July 2019, CLZhao 15997; the stump of *Cinnamomum bodinieri* Levl., 25 July 2019, CLZhao 16073 (SWFC).

Ganoderma gibbosum (Blume & T. Nees) Pat., Annales du Jardin Botanique de Buitenzorg Suppl. 1: 114 (1897)

Specimens examined: the stump of angiosperm, 16 January 2019, CLZhao 11324 (SWFC).

Ganoderma lingzhi S.H. Wu, Y. Cao & Y.C. Dai, Fungal Diversity 56(1): 54 (2012)

Specimens examined: the stump of *Cerasus* Mill., 25 July 2019, CLZhao 16116 (SWFC).

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

Specimens examined: the stump of angiosperm, 15 January 2019, CLZhao 11058 (SWFC).

Heteroradulum niveum J.J. Li & C.L. Zhao, in Li, Zhao & Liu, Diversity 14(1, no. 40): 5 (2022)

Specimens examined: the trunk of angiosperm, 26 July 2019, CLZhao 16483; the fallen branch of angiosperm, 16 January 2019, CLZhao 11204, 11210; 25 July 2019, CLZhao 16260, 16280; 26 July 2019, CLZhao 16398, 16424, 16432, 16472 (SWFC).

Hydnochaete tabacinoides (Yasuda) Imazeki, Bull. Tokyo Sci. Mus. 6: 103 (1943)

Specimens examined: the fallen branch of angiosperm, 14 January 2019, CLZhao 10804, 10823 (SWFC).

Hymenochaete innexa G. Cunn., Transactions and Proceedings of the Royal Society of New Zealand 85(1): 47 (1957)

Specimens examined: the trunk of angiosperm, 23 January 2019, CLZhao 12082; the dead angiosperm tree, 23 January 2019, CLZhao 12017 (SWFC).

Hymenochaete minor S.H. He & Y.C. Dai, Fungal Diversity 56: 84 (2012)

Specimens examined: the dead angiosperm tree, 23 January 2019, CLZhao 11986 (SWFC).

Hymenochaete muroiana I. Hino & Katum., Icones fungorum bambusicolorum Japonicorum: 237 (1961)

Specimens examined: the dead bamboo, 23 January 2019, CLZhao 12080 (SWFC).

Hymenochaete porioides T. Wagner & M. Fisch., Mycol. Progr. 1(1): 101 (2002)

Specimens examined: the fallen branch of angiosperm, 9 January 2019, CLZhao 10176, 10232, 10242; 10 January 2019, CLZhao 10386 (SWFC).

Hymenochaete rheicolor (Mont.) Lév., Annls Sci. Nat., Bot., sér. 3 5: 151 (1846)

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10799, 10817, 10839, 10849; 15 January 2019, CLZhao 10884, 10895; 16 January 2019, CLZhao 11186, 11216 (SWFC).

Hymenochaete separabilis J.C. Léger, Bulletin de la Société Mycologique de France 97(1): 7 (1981)

Specimens examined: the fallen branch of angiosperm, 23 January 2019, CLZhao 11996 (SWFC).

Hyphoderma floccosum C.L. Zhao & Q.X. Guan, Mycosystema 40(3): 454 (2021)

Specimens examined: fallen branch of angiosperm, 26 July 2019, CLZhao 16492; 28 July 2019, CLZhao 17065, 17079, 17129, 17215, 17296 (SWFC).

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

Specimens examined: the fallen branch of angiosperm, 28 July 2019, CLZhao 17280 (SWFC).

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

Specimens examined: the trunk of angiosperm, 26 July 2019, CLZhao 16468; the

fallen branch of angiosperm, 27 July 2019, CLZhao 16801, 16896; the dead bamboo, 15 January 2019, CLZhao 11249 (SWFC).

Hyphoderma subsetigerum Sheng H. Wu, Mycologia 89(1): 136 (1997)

Specimens examined: the fallen branch of angiosperm, 25 July 2019, CLZhao 16201, 16206; 26 July 2019, CLZhao 16499; 28 July 2019, CLZhao 16934, 16955, 17232, 17319 (SWFC).

Hyphodontia pallidula (Bres.) J. Erikss., Symbolae Botanicae Upsalienses 16(1): 104 (1958)

Specimens examined: the trunk of angiosperm, 22 January 2019, CLZhao 11983 (SWFC).

Hyphodontia subglobosa Sheng H. Wu, Acta Botanica Fennica 142: 106 (1990)

Specimens examined: the fallen branch of angiosperm, 27 July 2019, CLZhao 16789, 16794, 16845 (SWFC).

Hyphodontia tropica Sheng H. Wu, Mycotaxon 76: 62 (2000)

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10664, 10706, 10746, 10761, 10768, 10784, 10797, 10834, 10843; 15 January 2019, CLZhao 10900, 11129; 23 January 2019, CLZhao 11991, 12115; 25 July 2019, CLZhao 16245; 26 July 2019, CLZhao 16429, 16485; 28 July 2019, CLZhao 16990; the fallen branch of angiosperm, 14 January 2019, CLZhao 10654, 10661, 10837; 15 January 2019, CLZhao 11135, 11140, 11144, 11147; 16 January 2019, CLZhao 11225; 23 January 2019, CLZhao 12006, 12009, 12069, 12118; 24 July 2019, CLZhao 16051; 26 July 2019, CLZhao 16285, 16459, 16490, 16505, 16520; 28 July 2019, CLZhao 17180; the dead angiosperm tree, 23 January 2019, CLZhao 12040; the fallen branch of *Camellia japonica* L., 23 January 2019, CLZhao 15949; the stump of angiosperm, 14 January 2019, CLZhao 10810; 16 January 2019, CLZhao 11226; 25 July 2019, CLZhao 16229 (SWFC).

Irpex lacteus (Fr.) Fr., Elenchus Fungorum 1: 145 (1828)

Specimens examined: the trunk of angiosperm, 23 January 2019, CLZhao 12048; the fallen branch of angiosperm, 15 January 2019, CLZhao 10931, 11017, 11027; 16 January 2019, CLZhao 11319; 22 January 2019, CLZhao 11953, 11969; 28 July 2019, CLZhao 17036; the fallen branch of *Picea asperata* Mast., 26 July 2019, CLZhao 16313; the stump of angiosperm, 25 July 2019, CLZhao 16213 (SWFC).

Laxitextum bicolor (Pers.) Lentz, U.S. Dept. Agric. Monogr. 24: 19 (1956)

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10765 (SWFC).

Lenzites betulinus (L.) Fr., Epicrisis Systematis Mycologici: 405 (1838)

Specimens examined: the stump of angiosperm, 27 July 2019, CLZhao 16848 (SWFC).

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

Specimens examined: the fallen branch of angiosperm, 16 January 2019, CLZhao 11237, 11248 (SWFC).

Lyomyces crustosus (Pers.) P. Karst., Revue Mycologique Toulouse 3(9): 23 (1881)

Specimens examined: the fallen branch of angiosperm, 23 January 2019, CLZhao 12025, 12049, 12097, 12111, 12151; 26 July 2019, CLZhao 16361; 28 July 2019, CLZhao 17141 (SWFC).

Lyomyces microfasciculatus (Yurchenko & Sheng H. Wu) Riebesehl & E. Langer, Mycological Progress 16(6): 647 (2017)

Specimens examined: the fallen branch of angiosperm, 24 July 2019, CLZhao 16047, 16067; 25 July 2019, CLZhao 16167, 16173, 16175, 16246, 16257, 26 July 2019, CLZhao 16445; 27 July 2019, CLZhao 16793, 16872; 28 July 2019, CLZhao 17297; the fallen branch of *Camellia japonica* L., 23 July 2019, CLZhao 15930 (SWFC).

Lyomyces orientalis Riebesehl, Yurchenko & E. Langer, Mycological Progress 16(9): 874 (2017)

Specimens examined: the fallen branch of angiosperm, 23 January 2019, CLZhao 12070; 24 July 2019, CLZhao 16068; 25 July 2019, CLZhao 16197, 16242; 27 July 2019, CLZhao 16798 (SWFC).

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

Specimens examined: the fallen branch of angiosperm, 25 July 2019, CLZhao 16183 (SWFC).

Megasporoporiella subcavernulosa (Y.C. Dai & Sheng H. Wu) B.K. Cui & Hai J. Li, Mycologia 105(2): 379 (2013)

Specimens examined: the fallen branch of angiosperm, 22 January 2019, CLZhao 11956, 11973, 23 January 2019, CLZhao 12002, 12005, 12106 (SWFC).

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

Specimens examined: the trunk of angiosperm, 14 January 2019, CLZhao 10632, 10808, 10835, 10847; the fallen branch of angiosperm, 15 January 2019, CLZhao 11093, 11134 (SWFC).

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

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3 DISCUSSION

In kingdom of fungi, two phyla Ascomycota and Basidiomycota cover around 97% of all fungal species (Willis 2018). According to the Ainsworth & Bisby's Dictionary of Fungi (Kirk *et al*. 2008), 1 589 genera and over 30 000 species were included in Basidiomycota (Dai *et al*. 2015) and many taxa were continuously recorded all over the world (Dai *et al*. 2015; Cui *et al*. 2019; Ayesha *et al*. 2020; Himani & Krishnappa 2020; Blanco-Dios 2021; Boonyuen *et al*. 2021; Kumar & Singh 2021; Zong *et al*. 2021a; Luo *et al*. 2022). Most new species were discovered from southern China (Wu *et al*. 2020), while Yunnan is the most important source of new species, sharing about 1/4 of total new species discovered in China (Dai *et al*. 2021). However, the diversity of wood-decaying fungi in Wenshan area is yet imperfectly investigated. The present paper is the first report of a series of studies on wood-decaying fungi in this area. In China, according to the previous studies (Dai 2011, 2012a; Dai *et al*. 2015, 2021; He & Zhao 2022) combined with field observations, 99 white-rot fungi and 5 brown-rot fungi were reported in the Wuliangshan area; 46 white-rot fungi and 3 brown-rot fungi were reported in Haikou Forestry Park; 73 white-rot fungi and 12 brown-rot fungi were reported in Huangshan Mountains; 93 white-rot fungi and 33 brown-rot fungi were reported in Great Xingan Mountains. In the present study, 2 923 specimens belonging to 104 wood-decaying poroid and corticioid species were collected from Wenshan area, including 5 brown rot species (4.81% of the total), *Dacryobolus karstenii*, *D. montanus*, *Lyomyces crustosus*, *Postia caesia* and *Trichaptum abietinum*, and 99 white rot species (95.19% of the total). Brown-rot fungi in Wenshan area account for 4.81% of the total wood-decaying fungi, while those in Haikou Forestry 6.12%, indicating that the

propotion of brown-rot fungi in the two areas seems similar (He *et al*. 2021; He & Zhao 2022). However, the proportion of brown-rot fungi to wood-decaying fungi in Huangshan Mountains and Great Xingan Mountains is 14.12%, 26.19%, respectively (Cui & Jia 2011; Cui & Yu 2011).

Some remarkable explorations of wood-decaying fungi have been made from Yunnan Province (Yuan & Dai 2008; Wu *et al*. 2017, 2021, 2022; Zhao & Wu 2017; Shen *et al*. 2018; Wu *et al*. 2018; Liu *et al*. 2019; Luo *et al*. 2019; Xu *et al*. 2019; Chen & Zhao 2020; Huang *et al*. 2020; Wang *et al*. 2020b; Gu & Zhao 2021; Luo *et al*. 2021, 2022; Qu *et al*. 2022), and nine new species, *Efibula yunnanensis*, *Gloeodontia yunnanensis*, *Heteroradulum niveum*, *Hyphoderma floccosum*, *Scytinostroma yunnanense*, *Xenasmatella tenuis*, *Xylodon grandineus*, *Xylodon sinensis* and *Xylodon wenshanensis*, were found from Wenshan area (Chen *et al*. 2020; Ma *et al*. 2020; Wang *et al*. 2020a; Guan & Zhao 2021; Luo *et al*. 2021, 2022; Zong *et al*. 2021b; Li *et al*. 2022). In the present paper 104 species obtained are distributed in 55 genera, 18 families, and 5 orders (Table 2). Of these 54 species belong to Polyporales, accounting for 51.92% of total species, indicating that Polyporales is the dominant group in this area; 38 species belong to Hymenochaetales, accounting for 36.54%, indicating that Hymenochaetales are the subdominant group in this area; 6 species belong to Russulales; 4 species belong to Auriculariales; 2 species belong to Trechisporales. Biogeographically, 75 species are rare and endemic (less than 5 specimens, Dai 2003, 2012a; Dai *et al*. 2010a), and 45 species are Eurasian. Fungal diversity in Wenshan area is still unpredictable and more intensive investigations are needed.

Wood-inhabiting poroid and corticioid fungi acting as wood decomposers release matter and energy to the ecological system in the forest ecosystems (Cui *et al*. 2006; Wei 2010; Gafforov *et al*. 2020; Dai *et al*. 2021). Previous studies have proved that *Auricularia cornea*, *A. delicate* and *A. villosula* are edible (Dai *et al*. 2010b; Wu & Dai 2015; Dai & Yang 2018; Wu *et al*. 2021), and *Antrodiella zonata*, *Auricularia delicata*, *Bjerkandera adusta*, *Irpex lacteus*, *Lenzites betulina*, *Pycnoporus sanguineus*, *Pyrrhoderma adamantinum*, *Trametes gibbosa*, *T. hirsute*, *T. versicolor*, *Trichaptum abietinum* and *T. biforme* are medicinal (Dai & Yang 2008; Wu *et al*. 2019). In which *Auricularia delicata* is simultaneously edible and medicinal (Dai & Yang 2008; Dai *et al*. 2010b). *Antrodiella zonata*, *Bjerkandera adusta* and *Ganoderma australe* were regarded as forest pathogens (Dai 2012b). All these species were reported in Wenshan area.

Previous research of the molecular systematics on the larger scale for the subphyla Agaricomycotina, Pucciniomycotina and Ustilaginomycotina combined with nLSU, SSU, 5.8S, rpb1, rpb2, and tef1 datasets (He *et al*. 2019) showed that 1 928 currently used genera names were distributed in 241 families, 68 orders, and 18 classes. In the present study, 104 species nested in 55 genera, 18 families, 5 orders based on ITS dataset are consistent with the previous studied topology (He *et al*. 2019). All collected fungal specimens from Wenshan area belonging to Agaricomycetes distribute over Auriculariales, Hymenochaetales, Polyporales, Russulales and Trechisporales. Phylogenetic analyses of all studied samples show that the individual taxon clusters closely with downloaded reliable sequence from previous studies with a supported rate (Fig. 1).

Comprehensive collection and researches of wood-decaying fungi in China have been carried out, and eighty pathogenic wood-decaying fungi mainly belonging to the families Ganodermataceae, Climacodontaceae, Corticiaceae, Hericiaceae, Hymenochataceae, Polyporaceae, Schizophyllaceae of Basidiomycota were reported (Dai *et al*. 2000). The investigation of wood-inhibiting fungi from Hainan area has yielded 240 species including 199 species of polypores, and 41 corticoid and other wood-inhabiting fungi (Ma *et al*. 2022). 1 819 species of wood-inhibiting fungi belonging to 509 genera were reported in China, which divided into 10 groups, including 196 species of larger ascomycetes, 21 jelly fungi, 47 coral fungi, 637 polyporoid, hydnaceous and thelephoroid fungi, 11

Table 2 Number of wood-inhabiting poroid and corticioid species in the main orders, families, and genera in the studied area and the proportion to total number of species

Order	Family	Genus	spp.	Proporation (%)	Genus	spp.	Proporation (%)
Auriculariales	Auriculariaceae	2	4	3.85	*Auricularia*	3	2.88
					Heteroradulum	1	0.96
	Subtotal	2	4	3.85			
Hymenochaetales	Hymenochaetaceae	6	12	11.54	*Fuscoporia*	2	1.92
					Hymenochaete	6	5.77
					Other genera (4)	4	3.85
	Hyphodontiaceae	1	3	2.88	*Hyphodontia*	3	2.88
	Rickenellaceae	1	3	2.88	*Peniophorella*	3	2.88
	Schizoporaceae	3	18	17.31	*Fibrodontia*	1	0.96
					Lyomyces	4	3.85
					Xylodon	13	12.50
	Incertae sedis	1	2	1.92	*Trichaptum*	2	1.92
	Subtotal	12	38	36.54			
Polyporales	Dacryobolaceae	2	4	3.85	*Dacryobolus*	2	1.92
					Postia	2	1.92
	Hyphodermataceae	1	4	3.85	*Hyphoderma*	4	3.85
	Incrustoporiaceae	1	3	2.88	*Skeletocutis*	3	2.88
	Irpicaceae	3	3	2.88	*Byssomerulius*	1	0.96
					Efibula	1	0.96
					Irpex	1	0.96
	Meruliaceae	4	7	6.73	*Phlebia*	4	3.85
					Climacodon	1	0.96
					Other genera (2)	2	1.92
	Phanerochaetaceae	3	6	5.77	*Phanerochaete*	3	2.88
					Bjerkandera	2	1.92
					Phlebiopsis	1	0.96
	Polyporaceae	17	25	24.04	*Ganoderma*	3	2.88
					Trametes	3	2.88
					Other genera (15)	19	18.27
	Steccherinaceae	2	2	1.92	*Antrodiella*	1	0.96
					Steccherinum	1	0.96
	Subtotal	33	54	51.92			
Russulales	Hericiaceae	1	1	0.96	*Laxitextum*	1	0.96
	Peniophoraceae	2	2	1.92	*Peniophora*	1	0.96
					Scytinostroma	1	0.96
	Stereaceae	1	1	0.96	*Aleurodiscus*	1	0.96
	Xenasmataceae	1	1	0.96	*Xenasmatella*	1	0.96
	Incertae sedis	1	1	0.96	*Gloeodontia*	1	0.96
	Subtotal	6	6	5.77			
Trechisporales	Hydnodontaceae	2	2	1.92	*Brevicellicium*	1	0.96
					Trechispora	1	0.96
	Subtotal	2	2	1.92			
Total	18	55	104	100	55	104	100

cantharelloid fungi, 653 agarics, 130 boletes, 75 gasteroid fungi, 16 larger pathogenic fungi, and 33 larger Myxomycetes (Li *et al*. 2015). 310 species belonging to 3 phyla, 8 class, 24 order, 66 family, 153 genera were reported in Saihanwula National Nature Reserve of Inner Mongolia, China (Liu & Li 2019). The wood-decaying fungi found in Wuliangshan area of Yunnan Province include 95 species belonging to Auriculariales, Boletales, Cantharellales, Corticiales, Gloeophyllales, Hymenochaetales, Polyporales, Russulales and Trechisporales of Basidiomycota (He & Zhao 2022). These reports indicate that the tropical and subtropical areas are rich in fungal diversity, and it goes without saying that the richness of the wood-decaying fungi is affirmative.

Dramatic changes in higher-level taxonomy in the last twenty years has added fungal phyla from 4 to 12 and the biodiversity of many hidden and microscopic species is undersampled, and the current researches indicate that perhaps less than 5% of the estimate two to four million species have been formally described (Blackwell 2011; Hawksworth & Lücking 2017; Dai *et al*. 2021). Enrichment of the knowledge of the fungal diversity worldwide for supporting the rational utilization and effective protection of fungal resources and providing scientific basis for the prevention and control of forest diseases is still a heavy task.

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