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A compendium of macrofungi of Pakistan by ecoregions

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Abstract

Macrofungi form fruiting bodies that can be detected with the naked eye in the field and handled by hand. They mostly consist of basidiomycetes, but also include some ascomycetes. Mycology in Pakistan is still in its infancy, but there have been many historical reports and checklists of macrofungi occurrence from its 15 ecoregions, which range from Himalayan alpine grasslands and subtropical pine forests to deserts and xeric shrublands. In this work, we searched and reviewed the historical literature and the GenBank database for compiling a comprehensive list of macrofungi reported from Pakistan to date. We recorded 1,293 species belonging to 411 genera, 115 families and 24 orders. These occurrences were updated taxonomically following the classification system currently proposed in the Index Fungorum website. The highest represented order by taxon number is Agaricales (47%) with 31 families, 146 genera and 602 species, followed by Polyporales (11%), Russulales (9%) and Pezizales (8%). Genera occurrence reported therein are presented for each ecoregion to the best of our ability given the data. We also discussed the currently known macrofungi diversity between different ecoregions in Pakistan. Overall, this work should serve as a solid foundation for the inclusion of Pakistan macrofungi in global biodiversity and conservation studies.

Keywords

Biodiversity, conservation, ecoregions, fungi, taxonomic list

Introduction

Fungi are amongst the most diverse groups of organisms on earth. There have been numerous estimates regarding the total number of fungi worldwide. Bisby and Ainsworth (1943) recorded the total number to be about 100,000 and later, Hawksworth (1991) hypothesised the total number of fungal species to be 1.5 million. Later, Blackwell (2011) estimated the total number of fungi to be around 3.5 – 5.1 million. More recently, Hawksworth and Lucking (2017) predicted the total number to be in the range of 2.8 to 3.8 million. To date, 149,974 species have been recognised (Index Fungorum 2021). The current rate of fungal species discovery per year averages at 2,000 as compared to 1,000 to 2,000 a decade ago (Cheek et al. 2020).

Macrofungi form fruiting bodies that can be detected with the naked eye in the field and handled by hand. They mostly consist of basidiomycetes, but also include some ascomycetes. They play many essential roles in ecosystems as mutualists, pathogens, decomposers or saprotrophs (Volk 2013). Some are edible, medicinal or toxic to humans. About 20,000 macrofungal species have been recognised worldwide (Hawskworth 2001), but many belong to cryptic species complexes and many more await discovery, particularly from poorly explored regions of the world.

A major hindrance of traditional systematics in fungal discovery and identification is the presence of limited taxonomic features (Wu et al. 2019). The traditional identification techniques utilised morphological features, ecological characters, physiology and biochemistry of tissues (Wang et al. 2016). The boom in molecular methods in the 1980s and a remarkable paper by White et al. (1990) describing rRNA primers in fungi spurred the beginning of molecular data utilisation in fungal classification and species identification. Phylogenetic studies have shown that morphologically similar taxa might belong to different lineages (e.g. Hibbett et al. 1997; Moncalvo et al. 2002). DNA sequences can also be helpful for detecting and distinguishing amongst cryptic taxa sharing similar morphological traits (e.g. Moncalvo and Buchanan 2008; Schoch et al. 2012; Wu et al. 2019).

Before the partition of British India, mycoflora of the region (presently India and Pakistan) was listed by Butler and Bisby (1931) and Mundkur (1938). These checklists recorded only 198 species of this region expanding on 30,000 square miles (77700 km^2). Later, Ahmad et al. (1997) recorded about 4,500 fungal taxa in a list that included all groups of fungi, i.e. macrofungi as well as microfungi and lichens. In the last two decades, many new records and description of new species have been added, based on morphological characters alone or in combination with molecular data (e.g. Sarwar et al. 2011; Saba et al. 2019a; Bashir et al. 2020a; Khalid in press), but none of these was comprehensively addressing macrofungal diversity in Pakistan and the ecoregions of their occurrence.

From a biodiversity conservation perspective, ecologists have been concerned about the factors that affect the delimitation of ecological units and how it affects our knowledge of ecological processes (Weins et al. 1985; Gosz 1991). Numerous efforts have been made to categorise geographical zones with analogous features. In a remarkable paper, Olson et al. (2001) defined ecoregions as broad areas of land or

water that consist of geographically distinct assemblages of taxa, natural communities and environmental conditions. They presented an ecoregion map for its utilisation at global as well as regional scales. They based their map on biogeographic information and this was built with the collaboration of more than 1,000 experts in biogeography, taxonomy, conservation biology and ecology from all over the world. Ecoregions were classified by taking into account biogeographic features like endemism, species richness and special evolutionary perspectives. The unique feature of this global biodiversity map is that it focuses on species allocation and communities more precisely than the earlier models, based on biophysical characters, for instance, rainfall and temperature (Holdridge 1967; Walter and Box 1976; Schultz 1995; Bailey 1998) or vegetation structure (UNESCO 1969; de Laubenfels 1975; Schmidthüsen 1976). In Olson et al. (2001), the terrestrial world is divided into 14 biomes, eight biogeographic realms and 867 ecoregions; out of which, nine biomes, two realms and 15 ecoregions are found in Pakistan. This country covers a wide altitudinal range from sea level (Arabian Sea) to the second highest peak of the world, K2. The variety of ecoregions from Himalayan alpine grasslands and subtropical pine forests to deserts and xeric shrublands promotes a great deal of fungal diversity that still remains largely unaccounted for.

In this study we compiled a compendium of macrofungi reported from Pakistan to date from searches in the historical literature as well as in the GenBank database. We have included fungi with prominent fruiting bodies visible to the naked eye in this taxonomic list. We have excluded taxa in Ascomycota which are immersed or half immersed structures, galls or non-prominent fruiting structures on animal dung. We also categorised the reported macromycetes into ecoregions, based on available data.

Materials and methods

Compendium of Macromycetes of Pakistan

For compiling a comprehensive compendium of macromycetes of Pakistan, data were gathered from extensive literature searches of checklists and published papers, as well as in the GenBank sequence database. Sequence data in GenBank (2020, 2021) was retrieved using a Python script written by Santiago Sanchez-Ramirez (available upon request) on 09-10-2020 for Basidiomycota and on 22-06-2021 for Ascomycota. The list was arranged following the current classification system in Index Fungorum (2021) with great care about eliminating synonymy.

Division of Macromycetes of Pakistan into Ecoregions

In order to attribute ecoregion occurrence of the taxa we retrieved, we used their locality-based information to consult various repositories, such as Ecoregion 2017 (Dinerstein et al. 2017), DOPA explorer (Dubois et al. 2018) and the ArcGis

search tool (2021). Ecoregion allocation of genera was graphically represented on an MS excel spreadsheet for analyses. Genera were listed in rows and ecoregions in columns. The presence or absence of a genus in an ecoregion was scored "1" or "0", respectively. The sum and percentage of each genus in each ecoregion were then calculated.

Results

Table 1 provides a comprehensive record of the macrofungal biota of Pakistan known to date, to the best of our knowledge. It lists 1,293 species belonging to 411 genera, 115 families and 24 orders. Out of which, 1,117 species, 338 genera, 83 families and 16 orders belong to Basidiomycota and 176 species, 73 genera, 32 families and eight orders are from Ascomycota. The source reference in Table 1 indicates that most entries are from the extensive checklist by Ahmad et al. (1997; 874 entries). The highest order recorded is Agaricales (27%) with 31 families, 146 genera and 602 species, followed by Polyporales (11%), Russulales (9%) and Pezizales (8%). The orders of least occurrences are Atheliales, Leotiales and Trechisporales representing one taxon in a single genus and family. The proportion of respective families, genera as well as species are shown in Fig. 1.

Table 2 indicates the ecoregions from which each genus was recorded. Fig. 2 shows that the highest macrofungal diversity is found in the western Himalayan

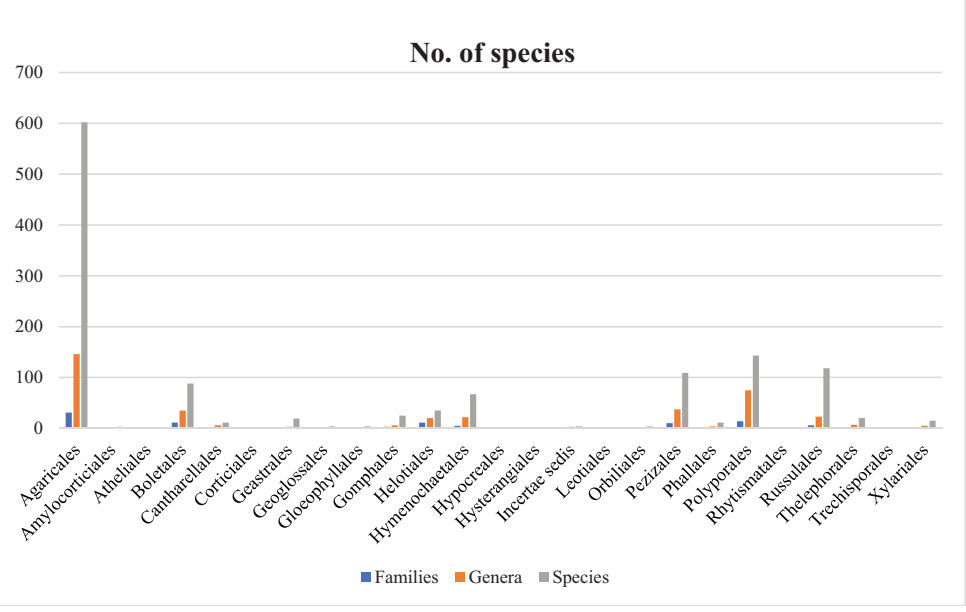

Figure 1. The Bar graph showing number of families, genera and species per order.

broadleaf forests (36%) followed by north-western thorn scrub forests (25%). In addition, Himalayan subtropical pine forests have rich macrofungal diversity with 17% taxa representation, followed by western Himalayan subalpine conifer forests with 13% distribution. The Karakorem West Tibetan Plateau alpine steppe and Baluchistan xeric woodlands show 5% or lesser distribution. On the other hand, the Indus River Delta, Arabian Sea mangroves, Thar Desert, Sulaiman range alpine meadows, East Afghan montane conifer forests, Registan north Pakistan sandy desert, south Iran Nubo-Sindian desert and semi-desert, Rann of Kutch seasonal marsh, as well as the north-western Himalayan alpine scrub and meadows have 0–2% macromycetes record.

Biomes and macrofungi occurrence details therein are presented in the supplementary document labelled "Macrofungi_list_by_biomes_and_ecoregions_of_Pakistan, whereas supplementary table entitled "Detailed_compendium_of_macrofungi_of_Pakistan" contains thorough information about synonymy, locality and taxa level ecoregion allocation.

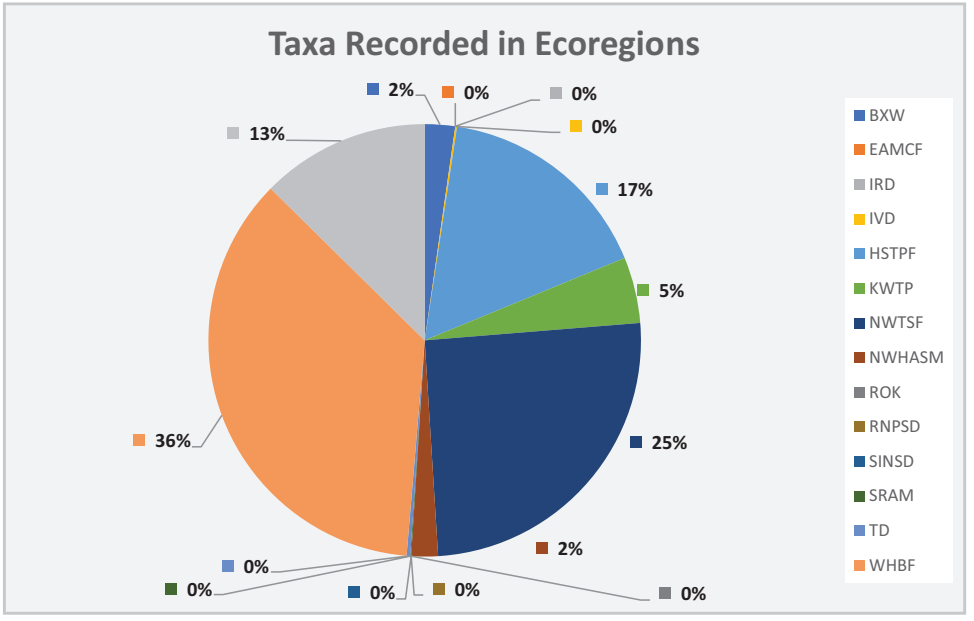

Figure 2. Percentage of macrofungi taxa in different ecoregions of Pakistan. Where, ***BXW*** = Baluchistan Xeric woodlands, ***EAMCF*** = East Afghan montane conifer forests, ***IRM*** = Indus River Delta Arabian Sea mangroves, ***IVD*** = Indus Valley Desert, ***HSTPF*** = Himalayan subtropical pine forests, ***KWTP*** = Karakorem West Tibetan Plateau alpine steppe, ***NWTSF*** = North-western thorn scrub forest, ***NWHASM*** = North-western Himalayan alpine scrub & meadows**,** ***RNPSD*** = Registan north Pakistan sandy desert, ***ROK*** = Rann of Kutch seasonal marsh, ***SINSD*** = South Iran Nubo-Sindian desert & semi-desert, ***SRAM*** = Sulaiman Range Alpine meadows, ***WHBF*** = Western Himalayan broadleaf forests, ***WHSACF*** = Western Himalayan subalpine conifer forests, ***TD*** = Thar Desert.

Table 1. A compendium of macrofungi of Pakistan. Note:FOP refers to checklist 'Fungi of Pakistan' (Ahmad et al. 1997).

Phylum/Order	Family	Genus	Species	Authority	Source
Basidiomycota/ Agaricales	Agaricaceae	*Agaricus*	*arvensis*	Schaeff.	FOP
			bisporiticus	Nawaz, Callac, Thongklang & Khalid	GenBank (KJ575608); Thongklang et al. (2014)
			bisporus	(J.E. Lange) Imbach	GenBank (KU170542); Sultana et al. (2011)
			bitorquis	(Quel.) Sacc.	GenBank (KU170541); FOP
			bolorhizus	Berk. & Broome	FOP
			callipelus	Berk. & Broome	FOP
			campestris	L.	Razaq et al. (2014)
			dulcidulus	Schulzer	Razaq et al. (2014)
			endoxanthus	Berk. & Broome	GenBank (MK101039); FOP
			glabriusculus	S. Hussain	GenBank (MK751855); Hussain and Sher (2019)
			goossensiae	Heinem.	GenBank (KU170540)
			gregariomyces	J.L. Zhou & R.L. Zhao	GenBank (MK101032)
			hemilasius	Berk. & Broome	FOP
			heterocystis	Heinem. & Gooss.-Font.	GenBank (KU170543)
			inoxydabilis	Heinem.	GenBank (KU170539)
			latiumbonatus	S. Hussain	GenBank (MK751859) ; Hussain and Sher (2019)
			lateriticolor	Heinem.	FOP
			latipes	Berk.	FOP
			pakistanicus	H. Bashir, A.N. Khalid, L.A. Parra & Callac	GenBank (MG669256); Bashir et al. (2018)
			placomyces	Peck.	FOP
			pseudopratensis	(Bohus) Bohus	GenBank (MK123324)
			punjabensis	Qasim, A. Ashraf & Khalid	GenBank (KT985908); Chen et al. (2016)
			rufoalbus	Berk.	FOP
			semotus	Fr.	FOP
			sinoplacomyces	P. Callac & R.L. Zhao	GenBank (KY741891)
			squalidus	Massee	FOP
			sparsisquamosus	H. Bashir, S. Hussain, A.N. Khalid & H. Ahmed	GenBank (MG669253); Sultana et al. (2011); Bashir et al. (2018)
			sylvaticus	Schaeff.	Sultana et al. (2011)
			trisulphuratus	Berk.	GenBank (KU170545); FOP; Sultana et al. (2011)
			woodrowii	Massee	FOP
			xanthodermus	Genev.	GenBank (KU170544)
		Baeospora	*myosura*	(Fr.) Singer	FOP
		Battarrea	*phalloides*	(Dicks.) Pers.	FOP; Yousaf et al. (2013a)
		Chamaemyces	*fracidus*	(Fr.) Donk.	FOP
		Chlorophyllum	*hortense*	(Murrill) Vellinga	GenBank (KM350689)
			molybdites	(G. Mey.) Massee	GenBank (MN577080); Razaq and Shahzad (2012)
			palaeotropicum	Z.W. Ge & A. Jacobs	GenBank (MN577079)
			rachodes	(Vittad.) Vellinga	FOP; Sultana et al. (2011)
		Coprinus	*comatus*	(Muell. Ex Fr.) S.F. Gray	GenBank (HE819398); FOP; Razaq et al. (2014c)
			hookeri	Berk.	FOP

Phylum/Order	Family	Genus	Species	Authority	Source
Agaricales	Agaricaceae	*Cystoderma*	*amianthinum*	(Scop.) Fayod	FOP
		Cystodermella	*cinnabarina*	(Alb & Schwein.) Harmaja	Razaq et al. (2013c)
			granulosa	(Batsch) Harmaja	FOP
		Cystolepiota	*pseudogranulosa*	(Berk. & Broome) Pegler	FOP
		Disciseda	*cervina*	(Berk) Hollos	FOP
		Echinoderma	*asperum*	(Pers.) Bon	FOP, Razaq et al. (2013a)
		Hymenagaricus	*alphitochrous*	(Berk. & Broome) Heinem.	FOP
		Lepiota	*albogranulosa*	Qasim & Khalid	Qasim et al. (2015b)
			anthomyces	(Berk. & Broome) Sacc.	FOP
			brunneoincarnata	Chodat & C. Martín	Razaq et al. (2013b)
			ceramogenes	(Berk. & Broome) Sacc.	FOP
			cholistanensis	H. Bashir, Usman & Khalid	Bashir et al. (2020a)
			cingulum	Kelderman	GenBank (MN240457)
			clypeolaria	(Bull.) P. Kumm.	GenBank (KJ906506)
			cristata	(Bolton) P. Kumm.	FOP; Razaq et al. (2013a)
			eriphaea	(Berk. & Br.) Sacc.	FOP
			erythrogramma	(Berk. & Br.) Sacc.	FOP
			himalayensis	Khalid & Razaq	Razaq et al. (2012a)
			ignivolvata	Bousset & Joss. ex Joss.	Sultana et al. (2011)
			lahorensis	Qasim & Khalid	GenBank (KT186609); Qasim et al. (2016)
			lepidophora	(Berk. & Broome) Sacc.	FOP
			leprica	(Berk. & Broome) Sacc.	FOP
			magnispora	Murrill	Sultana et al. (2011)
			metulispora	(Berk. & Broome) Sacc.	FOP
			micropholis	(Berk. & Broome) Sacc.	FOP
			ochraceofulva	P.D. Orton	Sultana et al. (2011)
			pardalota	Sacc.	FOP
			revelata	(Berk. & Broome) Sacc.	FOP
			subincarnata	J.E. Lange	FOP; Razaq et al. (2013b)
			vellingana	Nawaz & Khalid	Nawaz et al. (2013)
		Leucoagaricus	*asiaticus*	Qasim, Nawaz, & Khalid	Ge et al. (2015)
			badhamii	(Berk. & Broome) Singer	Sultana et al. (2011)
			badius	S. Hussain, Pfister, Afshan & Khalid	Hussain et al. (2018b)
			brunneus	Z. Ullah, Jabeen & Khalid	Ullah et al. (2019)
			lahorensiformis	S. Hussain, H. Ahmad, Afshan & Khalid	Hussain et al. (2018b)
			lahorensis	Qasim, T. Amir & Nawaz	Qasim et al. (2015a)
			leucothites	(Vittad.) Wasser	FOP
			nivalis	(W.F. Chiu) Z.W. Ge & Zhu L. Yang	GenBank (MK106148); Jabeen et al. (2020a)
			meleagris	(Gray) Singer	FOP
			pabbiensis	S. Jabeen & A.N. Khalid	GenBank (MG973423); Usman and Khalid (2018)
			pakistaniensis	S. Jabeen & A.N. Khalid	GenBank (KU647726); Hussain et al. (2018b)
			serenus	(Fr.) Bon & Boiffard	FOP; Sultana et al. (2011)
			sultanii	S. Hussain, H. Ahmad & Khalid	Hussain et al. (2018b)
			umbonatus	S. Hussain, H. Ahmad & Afshan	GenBank (KU647737); Hussain et al. (2018b)
			viriditinctus	(Berk. & Broome) J.F. Liang, Zhu L. Yang & J. Xu	FOP
		Leucocoprinus	*birnbaumii*	(Corda.) Singer	GenBank (KJ717764); FOP

Phylum/Order	Family	Genus	Species	Authority	Source
Agaricales	Agaricaceae	*Leucocoprinus*	*cepaestipes*	(Sw. ex Fr.) Pat.	FOP
			zeylanicus	(Berk.) Boedijn	FOP
		Macrolepiota	*dolichaula*	(Berk & Broome) Pegler & R.W. Rayner	GenBank (KJ643334); Fiaz et al. (2014)
			excoriata	(Schaeff.) Wasser	GenBank (KJ643333); Fiaz et al. (2014)
			procera	(Scop.) Singer	FOP
			venenata	Bon	Sultana et al. (2011)
		Micropsalliota	*arginea*	(Berk. & Broome) Pegler & R.W. Rayner	FOP
			brunneosperma	(Berk. & Broome) Höhn.	FOP
			plumaria	(Berk. & Broome) Höhn.	FOP
		Montagnea	*arenaria*	(DC) Zeller	FOP
		Mycenastrum	*corium*	(Guers.) Desv.	FOP
		Podaxis	*pistillaris*	(L.) Fr.	FOP
		Phellorinia	*herculeana*	(Pers.) Kreisel	Sultana et al. (2011); Yousaf et al. (2012b)
		Schizostoma	*laceratum*	Ehrenb. ex Fr.) Lév.	FOP
			mundkuri	(S. Ahmad) Long & Stouffer	FOP
		Tulostoma	*ahmadii*	H. Hussain & Khalid	GenBank (KP738711); Hussain et al. (2015b)
			amnicola	Long & S. Ahmad	FOP
			australianum	Lloyd	FOP
			balanoides	Long & S. Ahmad	FOP
			brumale	Pers.	FOP
			cineraceum	Long	FOP
			crassipes	Long & S. Ahmad	FOP
			egranulosum	Lloyd	FOP
			evanescens	Long & S. Ahmad	FOP
			exitum	Long & S. Ahmad	FOP
			hygrophilum	Long & S. Ahmad	FOP
			inonotum	Long & S. Ahmad	FOP
			ladhaerens	Lloyd	FOP
			macalpineanum	Lloyd	FOP
			mussooriense	Henn.	FOP
			occidentale	Lloyd	FOP
			operculatum	Long & S. Ahmad	FOP
			parvissimum	Long & S. Ahmad	FOP
			perplexum	Long & S. Ahmad	FOP
			pluriosteum	Long & S. Ahmad	FOP
			puncticulosum	Long & S. Ahmad	FOP
			squamosum	(J.F. Gmel.) Pers.	GenBank (KT285883); Hussain et al. (2015b)
			volvulatum	I.G. Borshch.	FOP
			vulgare	Long & S. Ahmad	FOP
			xerophilum	Long	FOP
		Xanthagaricus	*flavidorufus*	(Berk. & Broome) Little Flower, Hosag. & T.K. Abraham	FOP
			pakistanicus	S. Hussain, Afshan & H. Ahmad	GenBank (KY621555); Hussain et al. (2018c)
			subaeruginosus	(Berk. & Broome) S. Hussain	FOP; Hussain et al. (2018c)
	Amanitaceae	*Amanita*	*ahmadii*	Jabeen, I. Ahmad, M. Kiran, J. Khan & Khalid	GenBank (MF070490); Jabeen et al. (2019)
			battarrae	(Boud.) Bon	Tulloss et al. (2001); Sultana et al. (2011)

Phylum/Order	Family	Genus	Species	Authority	Source
Agaricales	Amanitaceae	*Amanita*	*caesarea*	(Scop.) Pers.	FOP
			ceciliae	(Berk. & Broome) Bas	FOP
			cinnamomescens	Tulloss, S.H. Iqbal, A.N. Khalid & Bhandary	Tulloss et al. (2005)
			cinis	S. Ullah, A.W. Wilson, Tulloss & Khalid	Ullah et al. (2019b)
			emodotrygon	Mehmood, Tulloss, K. Das, Hosen & R.P. Bhatt	Ullah et al. (2019b)
			flavipes	S. Imai.	FOP; Tulloss et al. (2001)
			glarea	Jabeen, M. Kiran & Sadiqullah	GenBank (KY817310); Jabeen et al. (2017c)
			griseofusca	J. Khan & M. Kiran	GenBank (MH241055); Kiran et al. (2018)
			hemibapha	(Berk. & Broome) Sacc.	FOP
			longistriata	S. Imai	FOP
			mansehraensis	M. Saba, Haelew. & A.N. Khalid	Saba et al. (2019b)
			muscaria	(L.) Lam.	GenBank (MK719200), FOP
			olivovaginata	S. Ullah, Tulloss & Khalid	Ullah et al. (2019a)
			orsonii	Ash. Kumar & T.N. Lakh.	GenBank (KU248132); Tulloss et al. (2001)
			pantherina	(DC.) Krombh	FOP; Sultana et al. (2011)
			pakistanica	Tulloss, S.H. Iqbal & Khalid	GenBank (KX061523); Tulloss et al. (2001)
			pallidorosea	P. Zhang & Zhu L. Yang	GenBank (KY621476); Kiran et al. (2017)
			phalloides	(Vaill. ex Fr.) Link	FOP
			porphyria	Alb. & Schwein.	FOP
			pseudovaginata	Hongo	GenBank (MT277138); Naseer and Khalid (2020a)
			rubescens	Pers.	FOP; Niazi et al. (2009)
			subjunquillea	S. Imai	GenBank (MH998627); Ishaq et al. (2019a)
			vaginata	(Bull.) Lam.	FOP
			verna	(Bull. Ex Fr.) Roques	FOP
			virosa	Bertill.	FOP
			watlingii	Kumar, BhattAsh. Kumar & T.N. Lakh.& Lakhanpal.	FOP
		Saproamanita	*nana*	(Singer) Redhead, Vizzini, Drehmel & Contu	FOP
		Limacella	*delicata*	(Fr.) Earle ex Konrad & Maubl.	FOP
		Limacellopsis	*guttata*	(Pers.) Zhu L. Yang, Q. Cai & Y.Y. Cui	FOP
		Zhuliangomyces	*pakistanicus*	Usman & Khalid	GenBank (MN240881); Usman and Khalid (2020a)
			illinitus	(Fr.) Redhead	FOP
	Bolbitaceae	*Bolbitius*	*titubans*	(Bull.) Fr.	FOP
		Conocybe	*khasiensis*	(Berk.) Watling	FOP
			macrocephala	Kühner & Watling	FOP
			mesospora	Kühner ex Watling	FOP
			pubescens	(Gillet) Kühner	FOP
			punjabensis	A. Izhar, H. Bashir & Khalid	GenBank (MK637515); Izhar et al. (2019)
			rickenii	(Jul. Schäff.) Kühner	FOP
			semiglobata	Kühner & Watling	FOP
			semiglobata var. campanulata	Hauskn.	GenBank (MT994769)
			tenera	(Schaeff.) Kühner	FOP

Phylum/Order	Family	Genus	Species	Authority	Source
Agaricales	Bolbitaceae	*Descolea*	*flavoannulata*	(Lj.N. Vassiljeva) E. Horak	Niazi et al. (2007)
			quercina	J. Khan & Naseer	GenBank (MF966634); Khan et al. (2017a)
	Callistosporiaceae	*Callistosporium*	*luteo-olivaceum*	(Berk. & M.A. Curtis) Singer	GenBank (KJ101607); Saba and Khalid (2014a)
		Macrocybe	*gigantea*	(Massee) Pegler & Lodge	GenBank (LK932287); Razaq et al. 2016b
		Pseudolaccaria	*pachyphylla*	(Fr.) Vizzini & Contu	GenBank (KJ906503)
	Clavariaceae	*Clavaria*	*rosea*	Fr.	FOP
			vermicularis	Batsch	FOP
		Clavulinopsis	*corniculata*	(Schaeff.) Corner	FOP
	Cortinariaceae	*Cortinarius*	*acetosus*	(Velen.) Melot	Razaq et al. (2014)
			brunneocarpus	Razaq & Khalid	GenBank (MN738695); Song et al. (2019)
			bulliardii	(Pers.) Fr.	FOP
			cinnamomeus	(L.) Gray	FOP
			claricolor	(Fr.) Fr.	Sultana et al. (2011)
			delibutus	Fr.	Sultana et al. (2011)
			elegantissimus	Rob. Henry	Sultana et al. (2011)
			gentilis	(Fr.) Fr.	Sultana et al. (2011)
			hinnuleus	Fr.	FOP
			longistipitatus	M. Saba, S. Jabeen, Khalid & Dima	GenBank (MF872641); Saba et al. (2017)
			leucopus	(Bull.) Fr.	GenBank (JN133921)
			melanotus	Kalchbr.	Sultana et al. (2011)
			olivaceofuscus	Kühner	Sultana et al. (2011)
			pakistanicus	A. Naseer & A. N. Khalid	Naseer et al. (2020b)
			percomis	Fr.	Sultana et al. (2011)
			pseudotorvus	A. Naseer, J. Khan & A.N. Khalid	GenBank (MN864286); Naseer et al. (2020b)
			purpureus	(Bull.) Bidaud, Moënne-Locc. & Reumaux	FOP
			rufo-olivaceus	(Pers.) Fr.	Sultana et al. (2011)
			sanguineus	(Wulfen) Gray	Sultana et al. (2011)
			subturbinatus	Rob. Henry	Sultana et al. (2011)
			violaceus	(L.) Gray	Sultana et al. (2011)
	Crepidotaceae	*Crepidotus*	*applanatus*	(Pers.) P. Kumm.	FOP
			caspari	Velen.	FOP
			epibryus	(Fr.) Quel.	FOP
			mollis	(Schaeff.) Staude	FOP
		Simocybe	*centunculus*	(Fr.) P. Karst.	Razaq and Shahzad (2017)
	Cyphellaceae	*Chondrostereum*	*purpureum*	(Pers.) Pouzar	FOP
	Entolomataceae	*Clitocella*	*mundula*	(Lasch) Kluting, T.J. Baroni & Bergemann	FOP
			popinalis	(Fr.) Kluting, T.J. Baroni & Bergemann	Sultana et al. (2011)
		Clitopilus	*apalus*	(Berk. & Broome) Petch	FOP
			hobsonii	(Berk.) P.D. Orton	FOP
			peri	(Berk. & Broome) Petch	FOP
			pinsitus	(Fr.) Joss.	FOP
			scyphoides	(Fr.) Singer	Sultana et al. (2011)
		Entoloma	*cetratum*	(Fr.) M.M. Moser	Sultana et al. (2011)
			gnophodes	Berk. & Broome) E. Horak	FOP
			gnaphalodes	(Berk. & Broome) E. Horak	FOP
			incanum	(Fr.) Hesler	FOP
			iodnephes	(Berk. & Broome) Pegler	FOP
			mougeotii	(Fr.) Hesler	Sultana et al. (2011)

Phylum/Order	Family	Genus	Species	Authority	Source
Agaricales	Entolomataceae	*Entoloma*	*papillatum*	(Bres.) Dennis	Sultana et al. (2011)
			polycolor	Blanco-Dios	FOP
			shandongense	T. Bau & J.R. Wang	GenBank (MT255022); Haelewaters et al. (2020)
		Leptonia	*gnaphodes*	(Berk. & Broome) Sacc.	FOP
		Rhodocybe	*truncata*	(Schaeff.) Singer	Sultana et al. (2011)
			subgilva	(Berk. & Broome) Pegler	FOP
	Hygrophoraceae	*Arrhenia*	*epichysium*	(Pers.) Redhead, Lutzoni, Moncalvo & Vilgalys	FOP
		Hygrocybe	*acutoconica*	(Clem.) Singer	Sultana et al. (2011)
			bresadolae	Quel.	FOP
			chlorophana	(Fr.) Wunsch	FOP
			conica	(Schaeff.) P. Kumm.	FOP; Sultana et al. (2011)
			nigrescens	(Quél.) Kühner	Sultana et al. (2011)
			ovina	(Bull.) Kühner	Sultana et al. (2011)
			spadicea	(Scop.) P. Karst. [as 'Hydrocybe']	Sultana et al. (2011)
		Hygrophorus	*alboflavescens*	A. Naseer & A.N Khalid	GenBank (MK066232); Naseer et al. (2019b)
			agathomus	Fr. (Fr.)	FOP
			chrysodon	(Batsch) Fr.	Razaq et al. (2014b)
			marzuolus	(Fr.) Bres.	Razaq and Shahzad (2005a)
			pudorinus	(Fr.) Fr.	GenBank (MK066233); Naseer et al. (2019b)
			scabrellus	A. Naseer & A.N Khalid	Genbak (MK066234); Naseer et al. (2019b)
	Hydnangiaceae	*Laccaria*	*amethystina*	Cooke	FOP
			bicolor	(Maire) P.D. Orton	Sultana et al. (2011)
			glioderma	(Fr.) Maire	FOP
			laccata	(Scop.) Cooke	Sultana et al. (2011)
			ohiensis	(Mont.) Singer	Sultana et al. (2011)
			tortilis	(Bolton) Cooke	Sultana et al. (2011)
	Hymenogas-traceae	*Galerina*	*marginata*	(Batsch) Kühner	FOP
		Gymnopilus	*aeruginosus*	(Peck.) Singer	FOP
			chrysimyces	(Berk.) Manjula	FOP
			chrysomyces	(Berk.) Pegler.	FOP
			chrysites	(Berk.) Singer	FOP
			dunensis	H. Bashir, Jabeen & Khalid	GenBank (MK088247); Bashir et al. (2020b)
			holocrocinus	(Berk.) Singer	FOP
			hybridus	(Gillet) Maire	FOP
			junonius	(Fr.) P.D. Orton	FOP
			lepidotus	Hesler	GenBank (MK584298); Bashir et al. (2018)
			penetrans	(Fr.) Murrill.	GenBank (MF136815); Khan et al. (2017b)
			sapineus	(Fr.) Murrill	FOP
			swaticus	J. Khan, Sher & Khalid	GenBank (MF149864); Khan et al. (2017b)
		Hebeloma	*anthracophilum*	Maire	Sultana et al. (2011)
			atrocoerulea	(Fr.) Singer.	FOP
			aff. Lutense		GenBank
			mesophaeum	(Pers.) Quél.	FOP; Razaq et al. (2017)
			pusillum	J.E. Lange	FOP
			sinapizans	(Paulet) Gillet	Sultana et al. (2011)
			theobrominum	Quadr.	Razaq et al. (2017)
		Naucoria	*bohemica*	Velen.	Sultana et al. (2011)
			conicopapillata	(Henn.) Sacc. & P. Syd.	FOP

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Agaricales	Hymenogastraceae	*Naucoria*	*salicis*	P.D. Orton	FOP
		Phaeocollybia	*pakistanica*	J. Khan, Sher & Khalid	GenBank (KY007615); Khan et al. (2016a)
		Psilocybe	*coronilla*	(Bull.) Noordel.	FOP
			semilanceata	(Fr.) P. Kumm.	Sultana et al. (2011)
	Inocybaceae	*Inocybe*	*aff. amblyspora*	Kühner	GenBank (HG796912)
			aff. cryptocystis	D.E. Stuntz	GenBank (HG796963)
			aff. glabripes	Ricken	GenBank (HG796964)
			aff. hirtella	Bres.	GenBank (HG796965)
			aff. nitidiuscula	(Britzelm.) Lapl.	GenBank (HG796966)
			ahmadii	Farooqi, Niazi & Khalid	GenBank (KX254462); Farooqi et al. (2017)
			amblyospora	Kühner	GenBank (KX254462)
			amicta	Kokkonen & Vauras	GenBank (KJ686344); Saba et al. (2015)
			argillacea	(Pers.) Singer	FOP
			asterospora	Quel.	FOP; Sultana et al. (2011)
			caroticolor	T. Bau & Y. G. Fan	GenBank (MH473144); Naseer et al. (2019c)
			cryptocystis	D.E. Stuntz	GenBank (KF679812)
			dulcamara	(Pers.) P. Kumm.	FOP
			fibrosa	(Sowerby) Gillet	Sultana et al. (2011)
			flocculosa	Sacc.	FOP
			fuscidula	Velen.	Sultana et al. (2011)
			glabripes	Ricken	FOP; Sultana et al. (2011)
			geophylla	P. Kumm.	FOP; Sultana et al. (2011); Razaq and Shahzad (2017)
			hirtella	Bres.	Sultana et al. (2011)
			inocybium	NA	FOP
			kohistanensis	Jabeen, I. Ahmad & Khalid	GenBank (KP316243); Jabeen et al. (2016a)
			leptocystis	G.F. Atk	GenBank (KX254461); Farooqi et al. (2017)
			napipes	J.E. Lange	Sultana et al. (2011); Razaq and Shahzad (2017)
			nitidiuscula	(Britzelm.) Lapl.	GenBank (HE862959); Ilyas et al. (2013a)
			oblectabilis	(Britz.) Sacc.	FOP
			posterula	(Britzelm.) Sacc.	FOP
			praetervisa	Quél.	Sultana et al. (2011)
			pyriodora	(Pers.) P. Kumm.	FOP
			shawarensis	A. Naseer & A.N. Khalid	GenBank (KY616964); Naseer et al. (2017b)
			vaccina	Kühner	Sultana et al. (2011)
		Inosperma	*adaequatum*	(Britzelm.) Matheny & Esteve-Raventos	Sultana et al. (2011)
			bongardii	(Weinm.) Matheny & Esteve-Rav.	FOP
			erubescens	(A. Blytt) Matheny & Esteve-Rav.	FOP; Sultana et al. (2011)
		Mallocybe	*agardhii*	(N. Lund) Matheny & Esteve-Rav.	Razaq and Shahzad (2017)
			velutina	Saba & Khalid	Saba and Khalid (2020)
		Pseudosperma	*brunneoumbonatum*	Saba & Khalid	GenBank (MG742419); Saba et al. (2020b)
			flavorimosum	Jabeen & Khalid	GenBank (MG495391); Jabeen and Khalid (2020)
			himalayense	(Razaq, Khalid & Kobayashi) Matheny & Esteve-Rav.	GenBank (MH745140); Liu et al. (2018)

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Agaricales	Inocybaceae	*Pseudosperma*	*mimicum*	(Massee) Matheny & Esteve-Rav	GenBank (KJ546158); Saba et al. (2015)
			pakistanense	(Z. Ullah, S. Jabeen, H. Ahmad & A.N. Khalid) Matheny & Esteve-Rav	GenBank (MF588965); FOP; Ullah et al. (2018)
			rimosum	(Bull.) Matheny & Esteve-Rav.	FOP; Sultana et al. (2011)
			squamatum	(J.E. Lange) Matheny & Esteve-Rav.	FOP
		Langermannia	*wahlbergii*	(Fr.) Dring	FOP
	Lycoperdaceae	*Apioperdon*	*pyriforme*	(Schaeff.) Vizzini	FOP
		Bovista	*bovistoides*	(Cooke & Massee) S. Ahmad	FOP
			concinna	S. Ahmad	FOP
			himalaica	Yousaf, Krieisel & Khalid	GenBank (JN411938); Yousaf et al. (2012a)
			longispora	Kreisel	FOP
			lycoperdoides	(Cooke) S. Ahmad	FOP
			plumbea	Pers.	GenBank (JX183694); Yousaf et al. (2014)
			polymorpha	Kreisel	FOP
			pusilla	(Batsch) Pers.	FOP
			trachyspora	(Lloyd) Kreisel	FOP
		Bovistella	*japonica*	Lloyd	Yousaf et al. (2012b)
		Bryoperdon	*acuminatum*	(Bosc) Vizzini	FOP
		Calvatia	*ahmadii*	Khalid & S.H. Iqbal	Khalid and Iqbal (2004)
			craniiformis	(Schwein.) Fr.	FOP
			cyathiformis	(Bose) Morgan	FOP
			fragilis	(Quél.) Morgan	GenBank (AJ486958)
			lilacina	(Mont. & Berk.) Henn.	Genbank (MN544913); Haelewaters et al. (2020)
		Lycoperdon	*atropurpureum*	Vittad.	FOP
			curtisii	Berk.	GenBank (MK414502)
			echinella	(Pat.) S. Ahmad	FOP
			excipuliforme	(Scop.) Pers.	FOP; Yousaf et al. (2012b)
			glabrescens	Berk.	FOP
			lahorense	N. Yousaf & A.N. Khalid	GenBank (MK414506); Yuan et al. (2020)
			molle	Pers.	Razaq and Shahzad (2005b)
			perlatum	Pers.	FOP
			pratense	Pers.	GenBank (MK414499); FOP
			pseudocurtisii	N. Yousaf & A.N. Khalid	GenBank (MK414505); Yuan et al. 2020
			rimulatum	Peck	FOP
			setiferum	Demoulin	FOP
			subterrania	Ahmad	FOP
			umbrinum	Pers.	FOP
	Lyophollaceae	*Hypsizygus*	*marmoreus*	(Peck) H.E. Bigelow	FOP
		Lyophyllum	*decastes*	(Fr.) Singer	FOP
			nigrescens	Hongo	FOP
		Sagaranella	*tesquorum*	(Fr.) V. Hofst., Clémençon, Moncalvo & Redhead	FOP
		Tephrocybe	*anthracophila*	(Lasch) P.D. Orton	FOP
			aff. platypus	(Kühner) M.M. Moser	GenBank (KY947353)
		Termitomyces	*acriumbonatus*	Usman & Khalid	GenBank (MT179690); Usman and Khalid (2020b)
			clypeatus	R. Heim,	FOP

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Agaricales	Lyophollaceae	*Termitomyces*	*eurrhizus*	(Berk.) R. Heim	FOP
			furfuracea	(Fr.) Gillet	FOP
			le-testui	(Pat.) R. Heim	FOP
			microcarpus	(Berk. & Broome) R. Heim	FOP; Sultana et al. (2011); Sultana et al. (2014)
			rabuorii	Otieno	Sultana et al. (2011)
			sheikhupurensis	Izhar, Khalid & H. Bashir	Izhar et al. (2020)
			striatus	(Beeli) Heim	FOP
			umkowaan	(Cooke & Massee) D.A. Reid	GenBank (KJ703245); Hussain et al. (2015c)
	Macrocystidiaceae	*Macrocystidia*	*cucumis*	(Pers.) Joss.	FOP
	Marasmiaceae	*Chaetocalathus*	*niduliformis*	(Murrill) Singer	FOP
		Collybiopsis	*biformis*	(Peck) R.H. Petersen	GenBank (MT162681)
			diminuta	(Berk. & Broome) R.H. Petersen	FOP
			peronata	(Bolton) R.H. Petersen	Sultana et al. (2011)
		Crinipellis	*rubiginosa*	Pat.	FOP; Sultana et al. (2011)
			scabella	(Alb. & Schwein.) Murrill	FOP; Sultana et al. (2011)
		Marasmius	*atrorubens*	(Berk.) Mont.	FOP
			corrugatiformis	Singer	FOP
			ferrugineus	Berk. & Broome	FOP
			graminum	(Lib.) Berk.	FOP
			griseoviolaceus	Petch	FOP
			haematocephalus	(Mont.) Fr.	FOP
			ochropus	Singer	FOP
			oreades	(Bolton) Fr.	GenBank (HF546217); Razaq et al. (2013d)
			palmivorus	Sharples	GenBank (MN559682)
			pulcherripes	Peck	FOP
			rotula	(Scop.) Fr.	FOP
			ruforotula	Singer	FOP
			tubulatus	Petch	FOP
	Mycenaceae	*Mycena*	*epipterygia*	(Scop.) Gray	FOP
			galericulata	(Scop.) Gray	FOP
			haematopus	(Pers.) P. Kumm.	FOP
			inclinata	(Fr.) Quél.	Sultana et al. (2011)
			leptocephala	(Pers.) Gillet	Sultana et al. (2011)
			metata	(Fr.) P. Kumm.	FOP
			pura	(Pers.) P. Kumm.	FOP; Razaq et al. (2014)
		Panellus	*stipticus*	(Bull.) P. Karst	FOP
		Xeromphalina	*tenuipes*	(Schwein.) A.H. Sm.	FOP
	Mythicomycetaceae	*Mythicomyces*	*corneipes*	(Fr.) Redhead & A.H. Sm.	GenBank (KY648897)
	Niaceae	*Merismodes*	*anomala*	(Pers.) Singer	FOP
	Omphalotaceae	*Anthracophyllum*	*nigritum*	(Lév.) Kalchbr.	FOP
		Gymnopus	*androsaceus*	(L.) Della Magg. & Trassin.	Sultana et al. (2011)
			barbipes	R.H. Petersen & K.W. Hughes	GenBank (MK450334); Saba et al. (2020a)
			dryophilus	(Bull.) Murrill	FOP; Sultana et al. (2011)
			dysodes	(Halling) Halling	GenBank (MT114698); Saba and Khalid (2020c)
			erythropus	(Pers.) Antonín, Halling & Noordel.	Sultana et al. (2011)
			fusipes	(Bull.) Gray	FOP; Sultana et al. (2011)
			hirtellus	(Berk. & Broome) Desjardin & B.A. Perry	FOP
			ocior	(Pers.) Antonín & Noordel.	GenBank (MK122769)
			subnudus	Ellis ex Peck) Halling	GenBank (MK307636)

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Agaricales	Omphalotaceae	*Omphalotus*	*olearius*	(DC.) Singer	FOP; Razaq and Shahzad (2017)
		Marasmiellus	*biformis*	(Peck) J.S. Oliveira	Oliveira et al. (2019)
			candidus	(Fr.) Singer	GenBank (KJ906507); FOP
			confluens	(Pers.) J.S. Oliveira	FOP; Sultana et al. (2011)
			inoderma	(Berk.) Singer ex Furneaux	FOP
			longistipes	Muh. Ali, Niazi & Khalid	Haelewaters et al. (2020)
			luxurians	(Peck) J.S. Oliveira	GenBank (KF803761); Saba and Khalid (2014c)
			menehune	(Desjardin, Halling & Hemmes) J.S. Oliveira.	GenBank (KF803762); Saba and Khalid (2014c)
			ramealis	(Bull.) Singer	FOP; Sultana et al. (2011)
			subnudus	(Ellis ex Peck) J.S. Oliveira.	Oliveira et al. (2019)
		Mycetinis	*alliaceus*	(Jacq.) Earle ex A.W. Wilson & Desjardin	Sultana et al. (2011)
			scorodonius	(Fr.) A.W. Wilson & Desjardin	Sultana et al. (2011)
		Rhodocollybia	*butyracea*	(Bull.) Lennox	FOP
			maculata	(Alb. & Schwein.) Singer	FOP; Sultana et al. (2011)
			prolixa	(Fr.) Antonín & Noordel	Sultana et al. (2011)
			utrorensis	A. Sattar, M. Kiran & Khalid	GenBank (MH220536); Sattar et al. (2018)
	Physalacriaceae	*Armillaria*	*mellea*	(Vahl) P. Kumm	Sultana and Rizwana (2007)
			omnituens	(Berk.) Sacc.	FOP
		Armillariella	*mellea*	(Vahl) P. Karst	FOP; Sultana et al. (2011)
			vara	(Berk.) Sacc.	FOP
		Desarmillaria	*tabescens*	(Scop.) R.A. Koch & Aime	Sultana et al. (2011)
		Flammulina	*phlegmatica*	(Berk.) Sacc.	FOP
			velutipes	(Curtis) Singer	FOP
			yunnanensis	Z.W. Ge & Zhu L. Yang	GenBank (MN388767)
		Hymenopellis	*radicata*	(Relhan) R.H. Petersen	FOP; Sultana et al. (2011)
		Strobilurus	*esculentus*	(Wulfen) Singer	Sultana et al. (2011)
			tenacellus	(Pers.) Singer	GenBank (KY070339)
		Xerula	*pudens*	(Pers.) Singer	FOP; Sultana et al. (2011)
			strigosa	Zhu L. Yang, L. Wang & G.M. Muell.	GenBank (LK932286)
	Pluteaceae	*Pluteus*	*ephebeus*	(Fr.) Gillet	FOP
			escharites	(Berk. & Broome) Sacc.	FOP
			fusconigricans	(Berk. & Broome) Sacc.	FOP
			laeticeps		FOP
			leoninus	(Schaeff.) P. Kumm.	FOP
			palumbinus	(Berk.) Sacc.	FOP
			pellitus	(Pers.) P. Kumm.	FOP
			petasatus	(Fr.) Gillet	FOP
			pulverulentus	Murrill	FOP
			squamosa	(Pers. ex Fr.) Kummer	FOP
			variabilicolor	Babos	GenBank
		Volvariella	*bingensis*	(Beeli) Shaffer	Sultana et al. (2014)
			castanea	(Massee) G.C. Rath	FOP
			media	(Schumach.) Singer	FOP
			pusilla	(Pers.) Singer	FOP
			taylorii	(Berk. & Broome) Singer	FOP
			woodrowiana	(Massee) Manjula	FOP
		Volvopluteus	*earlei*	(Murrill) Vizzini, Contu & Justo	GenBank (MT353644)
			gloiocephalus	(DC.) Vizzini, Contu & Justo	FOP; Sultana et al. (2011)
	Pleurotaceae	*Acanthocystis*	*gemmellari*	Inzenga) Konrad & Maubl	FOP

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Agaricales	Pleurotaceae	*Hohenbuehelia*	*atrocaerulea*	(Fr.) Singer	FOP
			petaloides	(Bull.) Schulzer	FOP
			reniformis	(G. Mey.) Singer	FOP
			testudo	(Berk.) Pegler	FOP
		Nothopanus	*candidissimus*	(Sacc.) Kühner	FOP
		Pleurotus	*atricapillus*	(Batsch.) Singer	FOP
			cystidiosus	O.K. Mill.	GenBank (KR149589); Hussain et al. (2015a)
			djamor	(Rumph. ex Fr.) Boedijn	GenBank (KX056435)
			dryinus	(Pers.) P. Kumm.	Sultana et al. (2011)
			flabellatus	Sacc.	FOP
			membranaceus	Massee	FOP
			nebrodensis	(Inzenga) Quél.	FOP
			ostreatus	(Jacq.) P. Kumm.	FOP
		Resupinatus	*applicatus*	(Batsch) Gray	FOP
			poriaeformis	(Pers.) Thorn, Moncalvo & Redhead	FOP
	Porotheleaceae	*Phloeomana*	*speirea*	(Fr.) Redhead	Sultana et al. (2011)
	Psathyrellaceae	*Britzelmayria*	*multipedata*	(Peck) D. Wächt. & A. Melzer	FOP
		Coprinellus	*campanulatus*	S. Hussain & H. Ahmad	Hussain et al. (2018a)
			disseminatisimilis	S. Hussain	Hussain et al. (2018a)
			disseminatus	(Pers.) J.E. Lange	FOP; Razaq et al. (2014)
			marculentus	(Britzelm.) Redhead, Vilgalys & Moncalvo	FOP
			micaceus	(Bull.) Vilgalys, Hopple & Jacq. Johnson	FOP
			ovatus	M. Kamran & S. Jabeen	Kamran and Jabeen (2020)
			radians	(Desm.) Vilgalys, Hopple & Jacq. Johnson	FOP; Sultana et al (2014)
			tenuis	S. Hussain	Hussain et al. (2018a)
		Coprinopsis	*atramentaria*	(Bull.) Redhead, Vilgalys & Moncalvo	GenBank (KM977767); FOP; Sultana et al. (2011)
			cinerea	(Schaeff.) Redhead, Vilgalys & Moncalvo	Razaq et al. (2014)
			lagopus	(Fr.) Redhead, Vilgalys & Moncalvo	FOP; Sultana et al. (2011)
			lagopides	(P. Karst.) Redhead, Vilgalys & Moncalvo	FOP
			macropus	(Berk. & Broome) Redhead, Vilgalys & Moncalvo	FOP
			patouillardii	(Quél.) Gminder	FOP; Sultana et al. (2011)
		Homophron	*spadiceum*	(P. Kumm.) Örstadius & E. Larss.	FOP
		Parasola	*auricoma*	(Pat.) Redhead Vilgalys & Hopple.	GenBank (KY461721); FOP; Hussain et al. (2018d)
			conopilea	(Fr.) A. Pearson & Dennis	Sultana et al. (2011)
			glabra	S. Hussain, Afshan, H. Ahmad & Khalid	GenBank (KY621805); Hussain et al. (2018d)
			lilatincta	(Bender & Uljé), Redhead, & Hopple	GenBank (KP886462); Hussain et al. (2016)
			malakandensis	S. Hussain, Afshan & H. Ahmad	GenBank (KP738713); Hussain et al. (2017)
			plicatilis	(Curtis) Redhead, Vilgalys & Hopple	FOP
			pseudolactea	Sadiqullah, S. Hussain & Khalid	GenBank (KY621799); Hussain et al. (2018d)
			schroeteri	(P. Karst.) Redhead, Vilgalys & Hopple	GenBank (KY461722)

Phylum/Order	Family	Genus	Species	Authority	Source
Agaricales	Psathyrellaceae	*Parasola*	*setulosa*	(Berk. & Broome) Redhead, Vilgalys & Hopple	FOP; Sultana et al. (2011)
		Psathyrella	*atomata*	(Fr.) Quél.	Sultana et al. (2011)
			ammophila	(Durieu & Lév.) P.D. Orton	Sultana et al. (2011)
			artemisiae	(Pass.) Konrad & Maubl.	Sultana et al. (2011)
			bipellis	Quél.) A.H. Sm.	Sultana et al. (2011)
			candolleana	(Fr.) Maire	GenBank (KJ917666); FOP; Sultana et al. (2011)
			corrugis	(Pers.) Konrad & Maubl.	FOP; Sultana et al. (2011)
			efflorescens	(Sacc.) Pegler	FOP
			flavogrisea	(Berk.) Pegler	FOP
			hirta	Peck	Sultana et al. (2011)
			nana	(Massee) Manjula	FOP
			piluliformis	(Bull.) P.D. Orton	FOP
			spadiceogrisea	(Schaeff.) Maire	FOP
			spintrigera	(Fr.) Konr & Maubl.	FOP
		Punjabia	*pakistanica*	(Usman & Khalid) D. Wächt. & A. Melzer	GenBank (MH366737); Hussain et al. (2018a)
	Schizophyllaceae	*Schizophyllum*	*commune*	Fr.	GenBank (MN178555); FOP
			radiatum	Fr.	FOP
		Stramatoscypha	*fimbriata*	(Fr.) Donk.	FOP
	Strophoriaceae	*Agrocybe*	*arvalis*	(Fr.) Singer	Sultana et al. (2011)
			broadwayi	(Murrill) Dennis	FOP
			manihotis	Pegler	FOP
			pediades	(Fr.) Fayod	GenBank (MK791714), FOP
			stercoraria	Pegler	FOP
			vervacti	(Fr.) Singer	Sultana et al. (2011)
		Deconica	*coprophila*	(Bull.) P. Karst.	FOP
			merdaria	(Fr.) Noordel.	FOP
			montana	(Pers.) P.D. Orton	FOP
			pseudobullacea	(Petch) Ram.-Cruz & Guzmán	FOP
		Hypholoma	*elongatum*	(Pers.) Ricken	Sultana et al. (2011)
			fasciculare	(Huds.) P. Kumm.	FOP; Sultana et al. (2011)
			marginatum	J.Schröt.	Sultana et al. (2011)
			radicosum	J.E. Lange	Sultana et al. (2011)
		Kuehneromyces	*mutabilis*	(Schaeff.) Singer & A.H. Sm.	FOP
		Melanotus	*proteus*	(Sacc.) Singer	FOP
		Pholiota	*aurivella*	(Batsch) P. Kumm.	FOP
			gummosa	(Lasch) Singer	GenBank (MT995199)
			lubrica	(Pers.) Singer	FOP
			lucifera	(Lasch.) Quel.	FOP
			populnea	(Pers.) Kuyper & Tjall.-Beuk.	FOP
			spumosa	(Fr.) Singer	FOP
			squarrosa	(Vahl) P. Kumm.	FOP
			tuberculosa	(Schaeff.) P. Kumm.	Sultana et al. (2011)
		Protostropharia	*semiglobata*	(Batsch) Redhead, Moncalvo & Vilgalys	FOP
		Stropharia	*aeruginosa*	(Curtis) Quél.	FOP
			ambigua	(Peck) Zeller	GenBank (MN957717)
			atroferruginea	M.B. Khan, Fiaz & A. N. Khalid	GenBank (MK141060); Khan et al. (2019)
	Tricholomataceae	*Leucopaxillus*	*paradoxus*	Costantin & L.M. Dufour Boursier [as 'paradoxa']	Sultana et al. (2011)

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Agaricales	Tricholomataceae	*Leucopaxillus*	*gentianeus*	(Quel.) Kotl.	FOP, Sultana et al. (2011)
		Tricholoma	*aurantium*	(Schaeff.) Ricken	FOP
			elegans	G. Stev.	FOP
			lascivum	(Fr.) Gillet	FOP
			matsutake	(S. Ito & S. Imai) Singer	GenBank (MT448907)
			myomyces	(Pers.) J.E. Lange	GenBank (HF546219)
			terreum	(Schaeff.) P. Kumm.	FOP
			ustale	(Fr.) P. Kumm.	Razaq et al. (2014)
			vaccinum	(Schaeff.) P. Kumm.	FOP; Sultana et al. (2011)
		Tricholomopsis	*decora*	(Fr.) Singer	FOP
			flammula	Métrod ex Holec	GenBank (FR822742); Razaq et al. (2012c)
			inamoenum	(FR.) Gill	Sultana et al. (2011)
			rutilans	(Schaeff.) Singer	FOP
			sulphurescens	Bres.	Sultana et al. (2011)
	Tubariaceae	*Cyclocybe*	*erebia*	(Fr.) Vizzini & Matheny	GenBank (MT994783), FOP
		Flammulaster	*carpophilus*	(Fr.) Earle ex Vellinga	FOP
			fulvoalbus	(Berk. & Broome) Pegler	FOP
		Tubaria	*conspersa*	(Pers.) Fayod	FOP
			furfuracea	(Pers.) Gillet	FOP
	Typhulaceae	*Pistillaria*	*filiformis*	Corner	FOP
		Clitocybe	*dealbata*	(Sowerby) P. Kumm.	FOP
			fragrans	(With.) P. Kumm.	Sultana et al. (2014)
			infundibuliformis	(Schaeff.) Quél.	FOP; Sultana et al. (2011)
			metachroa	(Fr.) P. Kumm	Sultana et al. (2011)
			nebularis	(Batsch) P. Kumm.	Sultana et al. (2011)
			squamulosa	(Pers.) P. Kumm.	Sultana et al. (2011)
			vibecina	(Fr.) Quél.	FOP
		Clitocybula	*lacerata*	(Scop.) Metrod	FOP
		Crucibulum	*laeve*	(Huds.) Kambly	FOP
		Collybia	*macra*	Sacc.	FOP
			reineckeana	Henn.	FOP
			triplicata	(Berk.) Sacc.	FOP
		Cyathus	*limbatus*	Tul. & C. Tul.	FOP
			olla	(Batsch) Pers.	GenBank (MH593250)
			stercoreus	(Schwein.) De Toni	FOP
		Fistulina	*hepatica*	(Schaeff.) With.	FOP
		Infundibulicybe	*gibba*	(Pers.) Harmaja	GenBank (MT994778); FOP
			kotanensis	M Ishaq, Fiaz & A.N. Khalid	GenBank (MN017278); Ishaq et al. (2019b)
			macrospora	M. Ali, J. Khan, Niazi & Khalid	GenBank (MT548910); Ali et al. (2020)
		Lactocollybia	*epia*	(Berk. & Broome) Pegler	FOP
			variicystis	D.A. Reid & Eicker	GenBank (MN250288)
		Lepista	*caffrorum*	(Kalchbr. & McOwen) Singer	FOP
			irina	(Fr.) H.E. Bigelow	GenBank (KJ194172); FOP
			nuda	(Bull.) Cooke	Sultana et al. (2011)
			sordida	(Schumach.) Singer	FOP
		Megacollybia	*platyphylla*	(Pers.) Kotl. & Pouzar	FOP; Sultana et al. (2011)
		Melanoleuca	*cinereifolia*	(Bon) Bon	GenBank (KJ182965); Saba and Khalid (2014b)
			direnses	F. Nawaz, Jabeen & Khalid	GenBank (KU556797); Nawaz et al. (2017)
			excissa	(Fr.) Singer	FOP
			graminicola	Kühner & Maire	Genbank (KX908113); Nawaz et al. (2017)

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Agaricales	Typhulaceae	*Melanoleuca*	*kashmirensis*	R. Khurshed, Z. Ullah, Jabeen, H. Ahmad & Khalid	GenBank (MK541789); Ullah et al. (2020a)
		Paralepista	*flaccida*	(Sowerby) Vizzini	FOP; Razaq et al. (2014)
		Secotium	*acuminatum*	Mont.	FOP
		Phaeolepiota	*aurea*	(Matt.) Maire	FOP; Razaq et al. (2014)
		Trogia	*infundibuliformis*	Berk. & Broome	FOP
	Incertae sedis	*Leucocybe*	*connata*	(Schumach.) Vizzini, P. Alvarado, G. Moreno & Consiglio	GenBank (HE819396); FOP; Razaq et al. (2012b)
		Henningsomyces	*candidus*	(Pers.) Kuntze	FOP
		Panaeolus	*acuminatus*	(P. Kumm.) Quél.	Sultana et al. (2011)
			cyanescens	Sacc.	FOP
			fimicola	(Pers.) Gillet	FOP; Sultana et al. (2011)
			papilionaceus	(Bull.) Quél.	GenBank (HE819397); Razaq et al. (2012b)
			rickenii	Hora.	FOP; Sultana et al. (2011)
			semiovatus	(Sowerby) S. Lundell & Nannf.	FOP
Amylocorticiales	Amylocorticiaceae	*Anomoloma*	*myceliosum*	(Peck) Niemelä & K.H. Larss.	FOP
		Athelia	*rolfsii*	(Curzi) C.C. Tu & Kimbr.	GenBank
	Incertae sedis	*Plicatura*	*crispa*	(Pers.) D.A. Reid	FOP
Atheliales	Atheliaceae	*Amphinema*	*byssoides*	(Pers.) J. Erikss	FOP
Boletales	Boletaceae	*Aureoboletus*	*gentilis*	(Quél.) Pouzar	Razaq and Shahzad (2013)
		Boletus	*barrowsii*	Thiers & A.H. Sm.	Niazi (2008)
			edulis	Bull.	FOP; Razaq and Shahzad (2013)
			erythropus	Krombh.	FOP
			himalayensis	Jabeen, Sarwar & Khalid	Sarwar et al. (2018a)
			pakistanicus	S. Sarwar & Khalid	GenBank (JQ178324); Sarwar and Khalid (2014)
			reticulatus	Schaeff.	Niazi (2008); Razaq and Shahzad (2013)
			reticuloceps	(M. Zang, M.S. Yuan & M.Q. Gong) Q.B. Wang & Y.J. Yao	GenBank (KJ131224)
			subvelutipes	Peck	FOP
		Butyriboletus	*appendiculatus*	(Schaeff.) D. Arora & J.L. Frank	FOP
		Caloboletus	*calopus*	(Pers.) Vizzini	FOP
		Chalciporus	*piperatus*	(Bull.) Bataille	Sultana et al. (2011); Razaq and Shahzad (2013)
		Cyanoboletus	*pulverulentus*	(Opat.) Gelardi, Vizzini & Simonini	FOP
		Hortiboletus	*kohistanensis*	A. Naseer, S. Sarwar & A.N. Khalid	GenBank (MK002767); Naseer et al. (2019a)
			rubellus	(Krombh.) Simonini, Vizzini & Gelardi	GenBank (KJ802928); Sarwar et al. (2016)
		Leccinum	*aurantiacum*	(Bull.) Gray	Razaq and Shahzad (2017); Sultana et al. (2011)
			scabrum	(Bull.) Gray	Sultana et al. (2011); Razaq and Shahzad (2017)
			ustale	(Berk.) E. Horak	FOP
			versipelle	(Fr. & Hök) Snell	Razaq and Shahzad (2017)
		Leccinellum	*crocipodium*	(Letell.) Della Magg. & Trassin.	Razaq and Shahzad (2017)
			pseudoscabrum	(Kallenb.) Mikšík	Razaq and Shahzad (2017)
		Neoboletus	*luridiformis*	(Rostk.) Gelardi, Simonini & Vizzini	GenBank (KJ802930); Sarwar et al. (2016)

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Boletales	Boletaceae	*Phylloporus*	*bibulosa*	(Lloyd) Ryv.	FOP
			brunneiceps	N.K. Zeng, Zhu L. Yang & L.P. Tang	GenBank (KY679591); Naseer et al. (2017a)
			rhodoxanthus	(Schwein.) Bres.	Sultana et al. (2011)
		Porphyrellus	*porphyrosporus*	(Fr. & Hök) E.-J. Gilbert	FOP; Razaq and Shahzad (2017)
		Pseudoboletus	*parasiticus*	(Bull.) Šutara	FOP
		Rubroboletus	*lupinus*	(Fr.) Costanzo, Gelardi, Simonini & Vizzini	Sultana et al. (2011)
		Strobilomyces	*longistipitatus*	D. Chakr. K. Das & S. Adhikari	GenBank (MK518064); Ullah et al. (2019a)
			strobilaceus	(Scop.) Berk.	FOP
		Tylopilus	*felleus*	(Bull.) P. Karst	Razaq and Shahzad (2017)
			pseudoscaber	Secr. ex A.H. Sm. & Thiers	GenBank (KJ775785); Sarwar et al. (2014a)
			sultanii	S. Sarwar, Khalid & Niazi,	GenBank (KJ775786); Sarwar et al. (2014a)
		Xanthoconium	*separans*	(Peck) Halling & Both	Gardezi (2003); Razaq et al. (2014)
			dryophilus	(Thiers) N. Siegel, C.F. Schwarz & J.L. Frank	Gardezi (2003)
			fulvus	Sarwar, I. Ahmad & Khalid	Hernández-Restrepo et al. (2016)
		Xerocomus	*ferrugineus*	(Schaeff.) Alessio	FOP
			indicus	Singer	FOP
			rubellus	Quél.	Niazi (2008)
			subtomentosus	(L.) Quél	Sultana et al. (2011); Razaq and Shahzad (2013)
	Coniophoraceae	*Coniophora*	*arida*	(Fr.) P. Karst.	FOP
			fusispora	(Cooke & Ellis) Cooke	FOP
		Gyrodontium	*sacchari*	(Spreng.) Hjortstam	FOP
	Diplocystidiaceae	*Gomphidius*	*glutinosus*	(Schaeff.) Fr.	FOP
		Gyrodon	*lividus*	(Bull.) Sacc.	Razaq and Shahzad (2017)
	Gastrosporiaceae	*Astraeus*	*hygrometricus*	(Pers.) Morgan	FOP; Yousaf et al. (2014)
		Gastrosporium	*simplex*	Mattir.	FOP
	Gomphidiaceae	*Chroogomphus*	*helveticus*	(Singer) M.M. Moser	FOP
			pakistanicus	M. Kiran & A.N. Khalid	GenBank (MK509771); Kiran et al. (2020)
			pruinosus	M. Kiran & A.N. Khalid	GenBank (MK509769); Kiran et al. (2020)
			roseolus	Y.C. Li & Zhu L. Yang	GenBank (LT576117); Razaq et al. (2016a)
			rutilus	(Schaeff.) O.K. Mill.	FOP
	Hygrophoropsi-daceae	*Leucogyrophana*	*mollusca*	(Fr.) Pouzar	FOP
			pinastri	(Fr.) Ginns & Weresub	FOP
		Melanogaster	*durissimus*	Cooke	FOP
	Rhizopogonaceae	*Rhizopogon*	*flavus*	Petch	FOP
	Sclerodermataceae	*Pisolithus*	*albus*	(Cooke & Massee) Priest	GenBank (MN295477)
			tinctorius	(Mont.) E. Fisch.	GenBank (KF802173); Razaq and Shahzad (2004)
		Scleroderma	*aff. cepa*	Pers.	GenBank (HG796946)
			areolatum	Ehrenb.	Yousaf et al. (2012c)
			aurantium	(L.) Pers.	GenBank (KF802172)
			bovista	Fr.	GenBank (KF802171); FOP
			cepa	Pers.	FOP
			chevalieri	Guzmán	Yousaf et al. (2012c)
			dictyosporum	Pat.	Yousaf et al. (2012c)
			flavidum	Ellis & Everh.	FOP

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Boletales	Sclerodermataceae	*Scleroderma*	*sinnamariense*	Mont.	FOP
			verrucosum	(Bull.) Pers.	FOP
	Serpulaceae	*Serpula*	*lacrymans*	(Wulfen) J. Schröt.	GenBank (AJ557312), FOP
	Suillaceae	*Suillus*	*americanus*	(Peck) Snell	GenBank (KX213755); FOP; Sarwar et al. (2011)
			bovinus	(L.) Roussel	Sultana et al. (2011); Razaq and Shahzad (2016)
			brevipes	(Peck) Kuntze	Sarwar et al. (2011); Sarwar and Khalid (2014b)
			collinitus	(Fr.) Kuntze	Sultana et al. (2011); Sarwar and Khalid (2014b)
			flavidus	(Fr.) J. Presl	Sarwar et al. (2012); Sarwar and Khalid (2014b)
			granulatus	(L.) Roussel	FOP; Sarwar et al. (2014b)
			grevillei	(Klotzsch) Singer	FOP
			himalayensis	B. Verma & M.S. Ready	GenBank (KR056819); Sarwar et al. (2018b)
			luteus	(L.) Roussel	Razaq and Shahzad (2016); Sultana et al. (2011)
			marginielevatus	S. Sarwar, Khalid & Dentinger	GenBank (KJ361512); Sarwar et al. (2015)
			placidus	(Bonord.) Singer	FOP; Sultana et al. 2011
			tomentosus	Singer	FOP; Niazi (2008); Sarwar and Khalid (2014b)
			triacicularis	B. Verma & M.S. Reddy	GenBank (KM677929); Sarwar et al. (2015)
			viscidus	(L.) Roussel	Razaq et al. (2019)
		Suillellus	*luridus*	(Schaeff.) Murrill	FOP
			queletii	(Schulzer) Vizzini, Simonini & Gelardi	FOP
	Tapinellaceae	*Pseudomerulius*	*aureus*	(Fr.) Jülich	FOP
		Tapinella	*atrotomentosa*	(Batsch) Šutara	FOP
			panuoides	(Fr.) E.-J. Gilbert	FOP
Cantharellales	Aphelariaceae	*Aphelaria*	*ceracea*	Corner	FOP
	Hydnaceae	*Cantharellus*	*cibarius*	Fr.	FOP
		Clavulina	*coralloides*	(L.) J. Schröt.	FOP
			cinerea	(Bull.) J. Schröt.	FOP
			cinerea var. gracilis	Rea, Trans	FOP
			rugosa	(Bull.) J. Schröt	FOP
		Craterellus	*cinereus*	(Pers.) Pers.	GenBank (MF374488); Naseer and Khalid (2018)
		Hydnum	*repandum*	L.	FOP
			rufescens	Fr.	FOP
		Multiclavula	*mucida*	(Pers.) R.H. Petersen	FOP
Corticiales	Punctulariaceae	*Dendrocorticium*	*polygonioides*	(P. Karst.) Donk	FOP
	Vuilleminiaceae	*Cytidia*	*salicina*	(Fr.) Burt.	FOP
Geastrales	Geastraceae	*Geastrum*	*argenteum*	Cooke	FOP
			clelandii	Lloyd	FOP
			corollinum	(Batsch) Hollós	FOP
			coronatum	Schaeff. ex J. Schröt.	FOP
			drummondii	Berk.	FOP
			fimbriatum	Fr.	Razaq and Shahzad (2007)
			lageniforme	Vittad.	FOP
			lageniforme var. ahmadii	Stanck.	FOP
			minimum	Schwein.	FOP
			nanum var. nanum	Pers.	FOP
			panjabense	S. Ahmad	FOP

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Geastrales	Geastraceae	*Geastrum*	*rufescens*	Pers.	FOP
			saccatum	Fr.	FOP
			striatum	DC.	FOP
			velutinum	Morgan	FOP
			triplex	Jungh.	FOP
		Myriostoma	*coliforme*	(Dicks.) Corda	Yousaf et al. (2013b)
		Sphaerobolus	*ingoldii*	Geml, D.D. Davis & Geiser	GenBank (MN957515)
			stellatus	Tode	FOP
Gloeophyllales	*Gloeophyllaceae*	*Gloeophyllum*	*sepiarium*	(Wulfen) P. Karst.	FOP
			striatum	(Fr.) Murrill	FOP
			subferrugineum	(Berk.) Bondartsev & Singer	FOP
		Neolentinus	*lepideus*	(Fr.) Redhead & Ginns	FOP; Razaq et al. (2018)
Gomphales	Clavariadelphaceae	*Clavariadelphus*	*elongatus*	J. Khan, Sher & Khalid	GenBank (MG768846); Sher et al. (2018)
			pakistanicus	Hanif & Khalid	GenBank (HQ379937); Hanif et al. (2014)
			pistillaris	(L.) Donk	FOP
			subfastigiatus	V.L. Wells & Kempton	GenBank (JX275756); Hanif and Khalid (2013)
			truncatus	Donk	FOP
	Gomphaceae	*Gomphus*	*clavatus*	(Pers.) Gray	FOP
			megasporus	Corner	FOP
		Phaeoclavulina	*abietina*	(Pers.) Giachini	Nasim et al. (2008)
			flaccida	(Fr.) Giachini	FOP
		Ramaria	*aurea*	(Schaeff.) Quél.	Razaq and Shahzad (2005c)
			botrytis	(Pers.) Bourdot	FOP
			flava	(Schaeff.) Quél.	FOP
			flava var. flava	(Schaeff.) Quél	FOP
			flavescentoides	Hanif & Khalid	GenBank (KC357769); Hanif et al. (2019)
			formosa	(Pers.) Quél.	Nasim et al. (2008)
			fragillima	(Sacc. & P. Syd.) Corner	FOP
			moelleriana	(Bres. & Roum.) Corner	FOP
			pallida	(Schaeff.) Ricken	FOP
			soluta	(P. Karst.) Corner	FOP
			stricta	(Pers.) Quél.	FOP
			subaurantiaca	Corner	FOP
		Turbinellus	*floccosus*	(Schwein.) Earle ex Giachini & Castellano	FOP
	Lentariaceae	*Lentaria*	*acuminata*	Berk.	FOP
			micheneri	(Berk. & M.A. Curtis) Corner	FOP
			surculus	(Berk.) Corner	FOP
Hymenochaetales	Hymenochaetaceae	*Aurificaria*	*indica*	(Massee) D.A. Reid	FOP
		Coltricia	*bambusicola*	(Henn.) D.A. Reid	FOP
			cinnamomea	(Jacq.) Murrill	FOP
			perennis	(L.) Murrill	GenBank (MN892531); FOP
		Fomitiporia	*punctata*	(P. Karst.) Murrill	FOP
			robusta	(P. Karst.) Fiasson & Niemelä	FOP
		Fuscoporia	*callimorpha*	(Lév.) Groposo, Log.-Leite & Góes-Neto	FOP
			ferruginosa	(Schrad.) Murrill	FOP
			senex	(Nees & Mont.) Ghob.-Nejh.	FOP
			torulosa	(Pers.) T. Wagner & M. Fisch.	FOP
		Hymenochaete	*cinnamomea*	(Pers.) Bres.	FOP

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Hymeno-chaetales	Hymenochaeta-ceae	*Hymenochaete*	*cruenta*	(Pers.) Donk	FOP
			leonina	Berk. & M.A. Curtis	FOP
			patelliformis	G. Cunn.	FOP
			rheicolor	(Mont.) Lév.	FOP
			rubiginosa	(Dicks.) Lév.	FOP
			semistupposa	Petch	FOP
			villosa	(Lev) Bres.	FOP
			xerantica	(Berk.) S.H. He & Y.C. Dai	FOP
		Hydnoporia	*tabacina*	(Sowerby) Spirin, Miettinen & K.H. Larss.	FOP
		Inocutis	*dryophila*	(Berk.) Murrill	FOP
			tamaricis	(Pat.) Fiasson & Niemelä	FOP
		Inonotus	*cuticularis*	(Bull.) P. Karst.	FOP
			hispidus	(Bull.) P. Karst.	FOP
			pachyphloeus	(Pat.) T. Wagner & M. Fisch.	FOP
			peristrophidis	S. Ahmad	FOP
			tabacinus	(Mont.) G. Cunn.	FOP
			tinctorius	(Quél.) S. Ahmad	FOP
			triqueter	P. Karst.	FOP
		Phellinopsis	*conchata*	(Pers.) Y.C. Dai	FOP
		Phellinus	*allardii*	(Bres.) S. Ahmad	FOP
			badius	(Cooke) G. Cunn.	FOP
			caryophylli	(Racib.) G. Cunn.	FOP
			contiguus	(Pers. ex Fr.) Bours. & Galz.	FOP
			fastuosus	Lév.) S. Ahmad	FOP
			gilvus	(Schwein.) Pat.	FOP
			gilvus var. scruposus	(Fr.) Ahmad	FOP
			igniarius	(L.) Quél.	FOP
			laevigatus	(P. Karst.) Bourdot & Galzin	FOP
			nilgheriensis	(Mont.) G. Cunn.	FOP
			pectinatus	(Klotzsch) Quél.	FOP
			pini	(Brot.) Pilát	FOP
			pini var. abietis f. microspora	Pilat.	FOP
			purpureagilvus	(Petch.) Ryvarden	FOP
			ribis	(Schumach.) Quél.	FOP
			ribis f. gymno-sporiae		FOP
			ribis f. lycil		FOP
			rimosus	(Berk.) Pilat.	FOP
		Phylloporia	*ribis*	(Schumach.) Ryvarden	FOP
			tiliae	L.W. Zhou	GenBank (MN080232)
			chrysites	(Berk.) Ryvarden	FOP
		Porodaedalea	*himalayensis*	(Y.C. Dai) Y.C. Dai	GenBank (MK995632)
			indica	Spirin, Y.C. Dai & Vlasák	GenBank (MN829552)
		Pseudoinonotus	*dryadeus*	(Pers.) T. Wagner & M. Fisch.	FOP
		Onnia	*tibetica*	Y.C. Dai & S.H. He	GenBank (MT050549)
			tomentosa	(Fr.) P. Karst.	FOP
		Tropicoporus	*linteus*	(Berk. & M.A. Curtis) L.W. Zhou & Y.C. Dai	FOP
		Xanthoporia	*radiata*	(Sowerby) Ţura, Zmitr., Wasser, Raats & Nevo	Razaq and Shahzad (2017)
	Hyphodontiaceae	*Hyphodontia*	*arguta*	(Fr.) J. Erikss.	FOP
			pallidula	(Bres.) J. Erikss.	FOP
	Oxyporaceae	*Oxyporus*	*latemarginatus*	(Durr. & Mont.)	FOP
			populinus	(Schumach.) Donk	FOP

Phylum/Order	Family	Genus	Species	Authority	Source
Hymeno-chaetales	Rickenellaceae	*Peniophorella*	*pubera*	(Fr.) P. Karst.	FOP
	Schizoporaceae	*Schizopora*	*paradoxa*	(Schrad.) Donk	FOP
		Xylodon	*raduloides*	Riebesehl & Langer	FOP
	Incertae sedis	*Trichaptum*	*abietinum*	(Pers. ex J.F. Gmel.) Ryvarden	FOP
			biforme	(Fr.) Ryvarden	FOP
Hysterangiales	Phallogastraceae	*Protubera*	*clathroidea*	Dring	FOP
			maracuja	Möller	FOP
Phallales	Phallaceae	*Colus*	*hirudinosus*	Cavalier & Séchier	FOP
		Itajahya	*rosea*	(Delile) E. Fisch.	GenBank (KF481955); FOP; Moreno et al. (2013)
		Lysurus	*borealis*	(Burt) Henn.	FOP
			pakistanicus	S.H. Iqbal, Kasuya, Khalid & Niazi	Iqbal et al. (2006)
			periphragmoides	(Klotzsch) Dring	FOP
		Phallus	*calongei*	G. Moreno & Khalid	GenBank (KF481955); Moreno et al. (2009)
			celebicus	Henn.	FOP
			hadriani	Vent.	GenBank (KF481956); Moreno et al. (2013)
			impudicus	L.	FOP
			indusiatus	Vent.	FOP
			rubicundus	(Bose.) Fr.	FOP
Polyporales	Fomitopsidaceae	*Antrodia*	*subtrametes*	(Pilat.)	FOP
		Brunneoporus	*juniperinus*	(Murrill) Zmitr.	GenBank (KR610980)
		Cellulariella	*warnieri*	(Durieu & Mont.) Zmitr. & Malysheva	GenBank (MT491098)
		Phaeodaedalea	*incerta*	(Curr.) Ţura, Zmitr., Wasser & Spirin	FOP
		Pilatoporus	*ostreiformis*	(Berk.) Zmitr.	FOP
		Ranadivia	*stereoides*	(Fr.) Zmitr.	FOP
		Resinoporia	*crassa*	(P. Karst.) Audet	FOP
		Rhodofomes	*roseus*	(Alb. & Schwein.) Kotl. & Pouzar	FOP
	Dacryobolaceae	*Jahnoporus*	*oreinus*	Spirin, Vlasák & Miettinen	GenBank (MN178648)
		Fomitopsis	*annosa var indicus*	(Wakef.) S. Ahmad	FOP
			pinicola	(Sw.) P. Karst.	FOP
			rufolaccata	(Bose) Dhanda	FOP
		Postia	*tephroleuca*	(Fr.) Jülich	FOP
	Panaceae	*Panus*	*rudis*	Fr.	FOP
	Irpicaceae	*Byssomerulius*	*corium*	(Pers.) Parmasto	FOP
		Ceriporia	*ferrugineocincta*	(Murrill) Ryvarden	FOP
			leptoderma	(Berk. & Broome) Ryvarden	FOP
			xylostromatoides	(Berk.) Ryvarden	FOP
		Gloeoporus	*thelephoroides*	(Hook.) G. Cunn.	FOP
		Flavodon	*flavus*	(Klotzsch) Ryvarden	GenBank (MN888947)
		Irpex	*flavus*	Klotzsch	FOP
			lacteus	(Fr.) Fr.	GenBank (KM977778)
		Leptoporus	*mollis*	(Pers.) Quél.	FOP
		Trametopsis	*cervina*	(Schwein.) Tomšovský	FOP
	Laetiporaceae	*Laetiporus*	*sulphureus*	(Bull.) Murrill	FOP; Razaq and Shahzad (2016)
		Phaeolus	*schweinitzii*	(Fr.) Pat.	GenBank (MN109971); FOP; Razaq and Shahzad (2016)
			weberiana	(Bres. & Henn. ex Sacc.) Ryv.	FOP
	Meruliaceae	*Climacodon*	*pulcherrimus*	(Berk. & M.A. Curtis) Nikol.	FOP
		Hydnophlebia	*chrysorhiza*	(Eaton) Parmasto	FOP

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Polyporales	Meruliaceae	*Irpiciporus*	*pachyodon*	(Pers.) Kotl. & Pouzar	FOP
		Phlebia	*rufa*	(Pers.) M.P. Christ.	FOP
			sedimenticola	(S. Ahmad) S. Ahmad	FOP
			tremellosa	(Schrad.) Nakasone & Burds.	FOP
		Sarcodontia	*spumea*	(Sowerby) Spirin	FOP
		Scopuloides	*hydnoides*	(Cooke & Massee) Hjortstam & Ryvarden	FOP
			leprosa	(Bourdot & Galzin) Boidin, Lanq. & Gilles	FOP
	Meripilaceae	*Rigidoporus*	*lineatus*	(Pers.) Ryvarden	FOP
			microporus	(Sw.) Overeem	FOP
			ulmarius	(Sowerby) Imazeki	FOP; Razaq and Shahzad (2016)
			vinctus	(Berk.) Ryvarden	FOP
			zonalis	(Berk.) Imazeki	FOP
	Phanerochaetaceae	*Bjerkandera*	*adusta*	(Willd.) P. Karst.	FOP; Razaq and Shahzad (2016)
		Aporium	*carayae*	(Schw.) Teixiera and Rogers	FOP
		Hyphodermella	*corrugata*	(Fr.) J. Erikss. & Ryvarden	FOP
		Phaeophlebiopsis	*ravenelii*	(Cooke) Zmitr.	FOP
		Phlebiopsis	*gigantea*	(Fr.) Jülich	FOP
			papyrina	(Mont.) Boid.	FOP
		Porostereum	*spadiceum*	(Pers.) Hjortstam & Ryvarden	FOP
		Rhizochaete	*filamentosa*	(Berk. & M.A. Curtis) J. Erikss	FOP
	Podoscyphaceae	*Abortiporus*	*biennis*	(Bull.) Singer	Razaq and Shahzad (2016); Khan et al. (2016b)
		Podoscypha	*elegans*	(G. Mey.) Pat.	GenBank (MH858811)
			parvula	(Lloyd) D.A. Reid	FOP
			petalodes	(Berk.) Boidin	FOP; GenBank (DQ917655)
			pusilla	(Berk.) Ryvarden	FOP
			warneckeana	(Henn.) Ryvarden	FOP
	Polyporaceae	*Cerioporus*	*leptocephalus*	(Jacq.) Zmitr.	FOP
			squamosus	(Huds.) Quél.	GenBank (MN888950); FOP; Razaq and Shahzad (2016)
			varius	(Pers.) Zmitr. & Kovalenko	FOP
		Coriolus	*hirtellus*	(Fr.) Murrill	FOP
		Coriolopsis	*occidentalis*	(Klotzsch) Murrill	FOP
		Cystostiptoporus	*indicus*	Dhanda & Ryvarden	FOP
		Daedalea	*dickinsii*	Yasuda	GenBank (KR019739); FOP
			pusillus	(Lev.) Singer	FOP
			quercina	(L.) Pers.	FOP
		Daedaleopsis	*confragosa*	(Bolton) J. Schröt.	FOP
		Earliella	*scabrosa*	(Pers.) Gilb. & Ryvarden	GenBank (MN888942)
		Epithele	*typhae*	(Pers.) Pat.	FOP
		Favolus	*grammocephalus*	(Berk.) Imazeki	FOP
			tenuiculus	P. Beauv.	FOP
		Fomes	*ajazii*	S.M. Hussain	FOP
			borneoensis	(Lloyd) S. Ahmad	FOP
			fomentarius	(L.) Fr.	FOP; Razaq and Shahzad (2016)
			semitostus	(Berk.) Cooke	FOP
		Funalia	*floccosa*	(Jungh.) Zmitr. & Malysheva	FOP
			hispida	(Bagl.) M.M. Chen	FOP

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Polyporales	Polyporaceae	*Funalia*	*leonina*	(Klotzsch) Pat.	FOP
		Ganoderma	*ahmadii*	Staeyart.	FOP
			applanatum	(Fr.) Pat.	FOP; Razaq and Shahzad (2017)
			australe	(Fr.) Pat.	FOP
			flexipes	Pat.	FOP
			leucocontextum	T.H. Li, W.Q. Deng, Sheng H. Wu, Dong M. Wang & H.P. Hu	GenBank (MK713839)
			lucidum	(Curtis) P. Karst.	GenBank (KX610998)
			resinaceum	Boud.	FOP
			tornatum	(Pers.) Bres.	FOP
		Grammothele	*fuligo*	(Berk. & Broome) Ryvarden	FOP
		Hexagonia	*discopoda*	Pat. & Har.	FOP
		Lopharia	*cinerascens*	(Schwein.) G. Cunn.	FOP
			papyracea	(Bres.) D.A. Reid	FOP
		Lentinus	*arcularius*	(Batsch) Zmitr.	FOP
			brumalis	(Pers.) Zmitr.	FOP
			crinitus	(L.) Fr.	FOP
			multicolor	Berk.	FOP
			prolifer	(Pat. & Har.) D.A. Reid	FOP
			squarrosulus	Mont.	FOP
			tigrinus	(Bull.) Fr.	GenBank (EU543989)
		Lenzites	*betulinus*	(L.) Fr.	GenBank (MN888944); FOP
			platyphyllus	Lev.	FOP
		Perenniporia	*medulla-panis*	(Jacq.) Donk	FOP
		Picipes	*badius*	(Pers.) Zmitr. & Kovalenko	Razaq and Shahzad (2016)
			submelanopus	(H.J. Xue & L.W. Zhou) J.L. Zhou & B.K. Cui	GenBank (MN888945)
		Polyporellus	*picipes*	(Fr.) P. Karst.	FOP
		Polyporus	*biennis*	(Bull.) Fr.	FOP
			calcuttensis	Bose	FOP
			umbellatus	(Pers.) Fr.	FOP; Razaq et al. (2014)
		Poria	*latemarginata*	(Durieu & Mont.) Cooke	FOP
			paradoxa	Schard. ex Fr.	FOP
		Pyrofomes	*demidoffi*	(Lév.) Kotl. & Pouzar	FOP
			juniperinus	(H. Schrenk) Vlasák & Spirin	FOP
		Tomophagus	*colossus*	(Fr.) Murrill	FOP
		Trametes	*cingulata*	Berk.	FOP
			corrugata	(Pers.) Bres.	FOP
			elegans	(Spreng.) Fr.	GenBank (MN888943); FOP
			flavida	(Lév.) Zmitr., Wasser & Ezhov	FOP
			ijubarskii	Pilat.	FOP
			incana	Berk.	FOP
			lactinea	(Berk.) Sacc.	FOP
			ochracea	(Pers.) Gilb. & Ryvarden	FOP
			polyzona	(Pers.) Justo	FOP
			pubescens	(Schumach.) Pilát	FOP
			roseola	Pat. & Har.	FOP
			suaveolens	(L.) Fr.	FOP
			tephroleuca	Berk.	FOP
			trogii	Berk.	FOP
			versicolor	(L.) Lloyd	GenBank (KU697312); Razaq et al. (2014)

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Polyporales	Polyporaceae	*Truncospora*	*livida*	(Kalchbr. ex Cooke) Zmitr.	FOP
			tephropora	(Mont.) Zmitr.	FOP
	Incrustoporiaceae	*Tyromyces*	*chioneus*	(Fr.) P. Karst.	FOP
			gollanii	(Massee) S. Ahmad	FOP
	Pycnoporellaceae	*Pycnoporellus*	*fulgens*	(Fr.) Donk.	FOP
		Pycnoporus	*cinnabarinus*	(Jacq.) P. Karst.	FOP
		Pycnoporus	*sanguineus*	(L.) Murrill	FOP
	Sparassidaceae	*Sparassis*	*crispa*	Wulf. ex Fr.	FOP
			laminosa	Fr.	FOP
			latifolia	Y.C. Dai & Zheng Wang	GenBank (KF866226)
	Steccherinaceae	*Cabalodontia*	*queletii*	(Bourdot & Galzin) Piątek	FOP
		Odontia	*bicolor*	(Alb. & Schwein. ex Fr.) Quel.	FOP
			calcicola	(Bourdot & Galzin) Kõljalg	FOP
		Antrodiella	*oleaginea*	Overh. ex Ryvarden	FOP
		Mycorrhaphium	*stereoides*	(Cooke) Maas Geest.	FOP
		Steccherinum	*ochraceum*	(Pers. ex J.F. Gmel.) Gray	FOP
	Incertae sedis	*Amaropostia*	*stiptica*	(Pers.) B.K. Cui, L.L. Shen & Y.C. Dai	FOP
		Hypochnicium	*punctulatum*	(Cooke) J. Erikss.	FOP
		Phanerodontia	*chrysosporium*	(Burds.) Hjortstam & Ryvarden	GenBank (EU543990)
Russulales	Auriscalpiaceae	*Auriscalpium*	*vulgare*	Gray	FOP
		Lentinellus	*micheneri*	(Berk. & M.A. Curtis) Pegler	FOP
			ursinus	(Fr.) Kuhner	FOP
	Bondarzewiaceae	*Albatrellus*	*roseus*	J. Khan, Sher & Khalid	GenBank (MF110285); Khan et al. (2018)
		Amylosporus	*campbellii*	(Berk.) Ryvarden	FOP
			succulentus	Jia J. Chen & L.L. Shen	GenBank (MK929297)
		Bondarzewia	*dickinsii*	(Berk.) Jia J. Chen, B.K. Cui & Y.C. Dai	FOP
		Heterobasidion	*amyloideopsis*	Saba, C.L. Zhao, Khalid & Pfister	Genbank (KT598384); Zhao et al. (2017)
			insulare	(Murrill) Ryvarden	FOP
			linzhiense	Y.C. Dai & Korhonen	GenBank (MH233930); Saba et al. (2018)
			orientale	Tokuda, T. Hatt. & Y.C. Dai.	GenBank (MH233931); Saba et al. (2018)
	Hericiaceae	*Hericium*	*cirrhatum*	(Pers.) Nikol.	GenBank (MN513042); Khan et al. (2020)
			clathroides	(Pall.) Pers.	FOP
			coralloides	(Scop.) Pers.	FOP
			erinaceus	(Bull.) Pers.	FOP
		Laxitextum	*bicolor*	(Pers.) Lentz	FOP
	Peniophoraceae	*Asterostroma*	*laxum*	Bres.	FOP
		Dichostereum	*pallescens*	(Schwein.) Boidin & Lanq.	FOP
			rhodosporum	(Wakef.) Boidin & Lanq.	FOP
		Duportella	*velutina*	Pat.	FOP
			tristicula	(Berk. & Broome) Reinking	GenBank (MH858266)
		Lachnocladium	*fulvum*	Corner	FOP
		Peniophora	*cinerea*	(Pers.) Cooke	FOP
			versiformis	(Berk. & M.A. Curtis) Bourdot & Galzin	FOP
		Scytinostroma	*cystidiatum*	Boidin	FOP
			portentosum	(Berk.& Curt.) Donk	FOP
	Russulaceae	*Russula*	*abbottabadensis*	Saba & Adamčík	GenBank (MZ364137); Adamčík et al. (2019)
			adusta	(Pers.) Fr.	Sultana et al. (2011)

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Russulales	Russulaceae	*Russula*	*ahmadii*	Jabeen, Razaq, Niazi, I. Ahmad & Khalid	Genbank (KU535608); Jabeen et al. (2017b)
			amethystina	Quél.	GenBank (KT953612)
			amoenicolor	Romagn.	Sultana et al. (2011)
			anthracina	Romagn.	GenBank (KR011879), Jabeen et al. (2016b)
			aurea	Pers.	FOP
			aurantioflava	Kiran & Khalid	GenBank (MN130074); Adamčík et al. (2019)
			azurea	Bres.	FOP
			badia	Quel.	FOP
			brevipes	Peck	Niazi et al. (2006)
			brunneopurpurea	Jabeen & Khalid	GenBank (KT953613); Jabeen et al. (2017a); Ahmad et al. (2019)
			caerulea	Fr.	Sultana et al. (2011)
			cessans	A. Pearson	GenBank (KF679816)
			chloroides	(Krombh.) Bres.	FOP
			cinnabarina	Berk.	FOP
			consobrina	(Fr.) Fr.	Sultana et al. (2011)
			cyanoxantha	(Schaeff.) Fr.	FOP; Razaq et al. (2019)
			decipiens	(Singer) Bon	Sultana et al. (2011)
			delica	Fr.	FOP
			densifolia	Secr. ex Gillet	FOP
			emetica	(Schaeff.) Pers.	FOP
			fellea	(Fr.) Fr.	FOP
			foetentoides	Razaq, Khalid & Niazi	GenBank (HE647707); Razaq et al. (2014a)
			foetida	C. Martin	FOP
			grata	Britzelm.	FOP; Razaq et al. (2019)
			integra	(L.) Fr.	FOP
			livescens	(Batsch). Bataille	GenBank (KM596858); Jabeen et al. (2015b)
			maculata	Quél.	Sultana et al. (2011)
			mansehraensis	Saba, Caboň & Adamčík	GenBank (KU886598)
			nitida	(Pers.) Fr.	Razaq et al. (2019)
			olivacea	(Schaeff.) Fr.	Razaq et al. (2019)
			paludosa	Britzelm.	Razaq et al. (2019); Sultana et al. (2011)
			pelargonia	Niolle	Razaq et al. (2019); Sultana et al. (2011)
			pectinatoides	Peck	FOP
			queletii	Fr.	FOP
			quercus-floribundae	M. Kiran & Adamčík	GenBank (MN053391); Crous et al. (2019)
			rosea	Pers.	FOP; Sultana et al. (2011); Razaq et al. (2019)
			rhodopodus	Zvára	FOP
			risigallina	(Batsch) Sacc.	GenBank (KF679818)
			romellii	Maire	Razaq et al. (2019); Sultana et al. (2011)
			rubricolor	Jabeen, Naseer & Khalid	Jabeen et al. (2020b)
			sanguinea	Fr.	FOP
			shanglaensis	S. Ullah, Khalid & Fiaz	GenBank (MK579183); Ullah et al. (2020b)
			sichuanensis	G.J. Li & H.A. Wen	GenBank (KM596859); Saba and Khalid (2015)
			swatica	Sarwar and Hanif	Genbank (MK389374); Sarwar et al. (2019)
			torulosa	Bres.	Sultana et al. (2011)

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Russulales	Russulaceae	*Russula*	*tuberculosa*	R. Heim	FOP
			velenovskyi	Melzer & Zvára	FOP
			vinosa	Lindblad	Sultana et al. (2011)
			violacea	Quél.	Sultana et al. (2011)
			xerampelina	(Schaeff.) Fr.	FOP
		Thelephora	*atlanticus*	Bon.	Sultana et al. (2011)
			badiosanguineus	Kühner & Romagn.	FOP
			controversus	Pers.	Sultana et al. (2011)
			deliciosus	(L.) Gray	FOP; Sultana et al. 2011
			deterrimus	Gröger	Sultana et al. (2011)
			hatsudake	Nobuj. Tanaka	FOP
			helvus	(Fr.) Fr.	Razaq and Shahzad (2012)
			lacunarum	Romagn. ex Hora	Sultana et al. (2011)
			mediterraneensis	Llistos. & Bellù	GenBank (MK607609)
			obscuratus	(Lasch) Fr.	Sultana et al. (2011); Razaq and Shahzad (2012)
			pubescens	Fr.	Razaq and Shahzad (2012)
			quietus	(Fr.) Fr.	Sultana et al. (2011)
			romagnesii	Bon	Sultana et al. (2011)
			sanguifluus	(Paulet) Fr.	GenBank (HE615155); FOP; Sultana et al. 2011; Ilyas et al. (2013b)
			scrobiculatus	(Scop.) Fr.	FOP; Sultana et al. (2011)
			semisanguifluus	R. Heim & Leclair	GenBank (HF559377); Sultana et al. (2011)
			torminosus	(Schaeff.) Pers.	FOP; Sultana et al. (2011)
			vietus	(Fr.) Fr.	Sultana et al. (2011)
			violascens	(J. Otto) Fr.	Sultana et al. (2011)
			scrobiculatus	(Scop.) Fr.	FOP
		Lactifluus	*brunneoviolascens*	(Bon) Verbeken	Sultana et al. (2011)
			glaucescens	(Crossl.) Verbeken	Razaq et al. (2014)
			pergamenus	(Sw.) Kuntze	Sultana et al. (2011)
			piperatus	(L.) Roussel	FOP; Sultana et al. (2011); Razaq and Shahzad (2012)
			rugatus	(Kühner & Romagn.) Verbeken	Sultana et al. (2011)
			vellereus	(Fr.) Kuntze	Sultana et al. (2011)
			volemus	(Fr.) Kuntze	Khan and Sher (2016c)
	Stereaceae	*Acanthofungus*	*ahmadii*	(Boidin) Sheng H. Wu, Boidin & C.Y. Chien	FOP
		Aleurodiscus	*jacksonii*	S. Ahmad	FOP
		Amylostereum	*chailletii*	(Pers.) Boidin	FOP
		Gloeocystidiellum	*porosum*	(Berk. & M.A. Curtis) Donk	FOP
		Stereum	*elegans*	(G. Mey.) Fr.	FOP
			frustulosum	(Pers.) Fr.	FOP
			gausapatum	(Fr.) Fr.	FOP
			hirsutum	(Willd.) Pers.	FOP
			ostrea	(Blume & T. Nees) Fr.	FOP
			princeps	(Jungh.) Lév.	FOP
			rugosum	Pers.	FOP
			sanguinolentum	(Alb. & Schwein.) Fr.	FOP
		Xylobolus	*subpileatus*	(Berk. & M.A. Curtis) Boidin	FOP
Incertae sedis	Incertae sedis	*Neoalbatrellus*	*caeruleoporus*	(Peck) Audet	Sultana et al. (2011)
Trechisporales	Hydnodontaceae	*Brevicellicium*	*olivascens*	(Bres.) K.H. Larss. & Hjortstam	FOP
	Bankeraceae	*Boletopsis*	*leucomelaena*	(Pers.) Fayod	FOP
		Hydnellum	*caeruleum*	(Hornem.) P. Karst.	FOP

Phylum/Order	Family	Genus	Species	Authority	Source
Thelephorales	Bankeraceae	*Hydnellum*	*concrescens*	(Pers.) Banker	FOP
			earlianum	Banker	FOP
		Sarcodon	*imbricatus*	(L.) P. Karst.	FOP
	Thelephoraceae	*Phellodon*	*niger*	(Fr.) P. Karst.	FOP
		Thelephora	*anthocephala*	(Bull.) Fr.	FOP
			arbuscula	Corner	FOP
			atra	Weinm.	FOP
			caryophyllea	(Schaeff.) Pers.	FOP
			fucoides	Corner	FOP
			iqbalii	Nasir & Hanif	GenBank (JX241471); Khalid and Hanif (2017)
			palmata	(Scop.) Fr.	FOP
			penicillata	(Pers.) Fr.	FOP
			terrestris	Ehrh. ex Fr.	FOP
		Tomentella	*bryophila*	(Pers.) M.J. Larsen	FOP
			coriaria	(Peck) Bourdot & Galzin	FOP
			griseo-cinnamomea	Wakef.	FOP
			punicea	(Alb. & Schwein.) J. Schröt.	FOP
	Incertae sedis	*Dendrothele*	*acerina*	(Pers.) P.A. Lemke	FOP
Ascomycota/ Geoglossales	Geoglossaceae	*Geoglossum*	*umbratile*	Sacc.	FOP
		Trichoglossum	*hirsutum*	(Pers.) Boud.	FOP
			octopartitum	Mains	FOP
			velutipes	(Peck) E.J. Durand	FOP
Helotiales	Calloriaceae	*Calloria*	*urticae*	(Pers.) J. Schröt. ex Rehm	GenBank (MN957392)
		Diplonaevia	*mollisioides*	(Sacc. & Briard) B. Hein	FOP
	Cenangiaceae	*Chlorencoelia*	*torta*	(Schwein.) J.R. Dixon	GenBank (MN957580)
		Velutarina	*rufo-olivacea*	(Alb. & Schwein.) Korf	FOP
	Helotiaceae	*Cyathicula*	*coronata*	(Bull.) Rehm	FOP
			cyathoidea	(Bull.) Thüm.	FOP
			dolosella	(P. Karst.) Dennis	FOP
			egenula	(Rehm) E. Müll.	FOP
		Hymenoscyphus	*calyculus*	(Fr.) W. Phillips	FOP
			scutula	(Pers.) W. Phillips	FOP
			scutula var. scutula	(Pers.) W. Phillips	FOP
			subferrugineus	(Nyl.) Dennis	FOP
			vitigenus	(De Not.) Dennis	FOP
		Tatraea	*macrospora*	(Peck) Baral	FOP
	Lachnaceae	*Incrucipulum*	*ciliare*	(Schrad.) Baral	FOP
		Lachnellula	*arida*	(W. Phillips) Dennis	FOP
			calyciformis	(Batsch) Dharne	FOP
		Lachnum	*bicolor*	(Bull.) P. Karst	FOP
			corticale	(Pers.) Nannf.	FOP
			indicus	(E.K. Cash) J.H. Haines & Dumont	FOP
			mollissiumum	(Fuckel) P. Karst.	FOP
			pudibundum	(Quél.) J. Schröt.	FOP
		Perrotia	*himalayensis*	E. Müll. & Dennis	FOP
	Mollisiaceae	*Tapesia*	*fusca*	(Pers.) Fuckel	FOP
			rosae	(Pers.) Fuckel	FOP
	Pezizellaceae	*Allophylaria*	*subhyalina*	(Rehm) Baral	FOP
		Calycina	*citrina*	(Hedw.) Gray	FOP
			chionea	(Fr.) Kuntze	FOP
	Ploettnerulaceae	*Pyrenopeziza*	*lavaterae*	E. Müll. & S. Ahmad	FOP
	Rutstroemiaceae	*Rutrstroemia*	*bolaris*	(Batsch) Rehm	FOP
			firma	(Pers.) P. Karst.	FOP
	Sclerotiniaceae	*Moellerodiscus*	*berberidis*	Dumont	FOP
		Lasiobelonium	*fuscum*	(E. Müll. & Dennis) Raitv.	FOP
	Thelebolaceae	*Thelebolus*	*crustaceus*	(Fuckel) Kimbr.	FOP
	Incertae sedis	*Cistella*	*geelmuydenii*	Nannf.	FOP

Phylum/Order	Family	Genus	Species	Authority	Source
Rhytismatales	Cudoniaceae	*Cudonia*	*circinans*	(Pers.) Fr.	FOP
	Hyaloscyphaceae	*Hyaloscypha*	*luteola*	S. Ahmad	FOP
Leotiales	Leotiaceae	*Leotia*	*lubrica*	(Scop.) Pers.	FOP
Orbiliales	Orbiliaceae	*Hyalorbilia*	*erythrostigma*	(W. Phillips) Baral & G. Marson	GenBank (MN957494)
		Orbilia	*auricolor*	(A. Bloxam) Sacc.	FOP
			curvatispora	Boud.	FOP
			leucostigma	(Fr.) Fr	FOP
Hypocreales	Bionectriaceae	*Hydropisphaera*	*erubescens*	(Roberge ex Desm.) Rossman & Samuels	GenBank (MN957491)
	Hypocreaceae	*Trichoderma*	*alutaceum*	Jaklitsch	FOP
Xylariales	Hypoxylaceae	*Daldinia*	*bakeri*	Lloyd	FOP
			concentrica	(Bolton) Ces. & De Not.	FOP
			vernicosa	Ces. & De Not.	FOP
	Xylariaceae	*Podosordaria*	*kurziana*	(Curr.) P.M.D. Martin	FOP
			leporina	(Ellis & Everh.) Dennis	FOP
			nigripes	(Klotzsch) P.M.D. Martin	FOP
			pyramidata	(Berk. & Broome) P.M.D. Martin	FOP
		Poronia	*indica*	S. Ahmad	FOP
			polyporoides	Henn.	FOP
		Xylosphaera	*ehrenbergii*	(Henn.) Dennis	FOP
		Xylaria	*hirtella*	Wakef.	FOP
			hypoxylon	(L.) Grev.	FOP
			mali	Fromme	FOP
			mellissii	(Berk.) Cooke	FOP
			polymorpha	(Pers.) Grev.	FOP
Pezizales	Ascobolaceae	*Ascobolus*	*americanus*	(Cooke & Ellis) Seaver	FOP
			denudatus	Fr.	FOP
			elegans	J. Klein	FOP
			furfuraceus	Pers.	FOP
			immersus	Pers.	FOP
			leveillei	Boud.	FOP
			michaudii	Boud.	FOP
			minutus	Boud.	FOP
			perplexans	Massee & E.S. Salmon	FOP
			quezelii	Faurel & Schotter	FOP
			scatigenus	(Berk. & M.A. Curtis) Brumm.	FOP
			subglobosus	Seaver	FOP
		Saccobolus	*citrinus*	Boud. & Torrend	FOP
			depauperatus	(Berk. & Broome) E.C. Hansen	FOP
			glaber	(Pers.) Lambotte	FOP
			succineus	Brumm.	FOP
			truncatus	Velen.	FOP
			versicolor	(P. Karst.) P. Karst.	FOP
	Ascodesmidaceae	*Ascodesmis*	*macrospora*	W. Obrist	FOP
			microscopica	(P. Crouan & H. Crouan) Le Gal	FOP
			sphaerospora	W. Obrist	FOP
			nigricans	Tiegh.	FOP
		Lasiobolus	*papillatus*	(Pers.) Sacc.	FOP
			trichoboloides	S.R. Khan & J.L. Bezerra	FOP
	Discinaceae	*Gyromitra*	*esculenta*	Pers. ex Fr.	FOP
			infula	(Schaeff.) Quél.	FOP
			khanspurensis	Jabeen & Khalid	GenBank (MF116159); Krisai-Greilhuber et al. (2017)

Phylum/Order	Family	Genus	Species	Authority	Source
Pezizales	Discinaceae	*Discina*	*ancilis*	(Pers.) Sacc.	FOP
	Helvellaceae	*Helvella*	*acetabulum*	(L.) Quél.	FOP
			albella	Quél.	GenBank (MN814023)
			atra	J. König	GenBank (KF679807); FOP
			bachu	Q. Zhao, Zhu L. Yang & K.D. Hyde	GenBank (MN959917)
			crispa	(Scop.) Fr.	FOP
			cupiliformis	Razaq et al., (2014)	Sultana et al. (2011)
			elastica	Bull.	FOP
			involuta	Q. Zhao, Zhu L. Yang & K.D. Hyde	GenBank (MW447509)
			lacunosa	Afzel.	FOP
			leucopus	Pers.	Razaq et al. (2014)
			monachella	(Scop.) Fr.	Razaq et al. (2014)
			pezizoides	Afzel.	FOP
			villosa	Schaeff.	FOP
		Paxina	*queletii*	(Bres.) Stangl	FOP
	Morchellaceae	*Morchella*	*crassipes*	(Vent.) Pers.	GenBank (KP670934)
			deliciosa	Fr.	GenBank (MW558089)
			esculenta	(L.) Pers.	FOP; GenBank (MT957957)
			elata	Fr.	GenBank (MT977069)
			pakistanica	Jabeen & Khalid	GenBank (KX306760); Hernández-Restrepo et al. (2016)
			pulchella	Clowez & Franç. Petit	GenBank (MF400857); Badshah et al. (2018)
			tridentina	Bres.	GenBank (MT584841)
		Verpa	*bohemica*	(Krombh.) J. Schröt.	FOP
	Pezizaceae	*Ahmadea*	*dalanensis*	Aman & Khalid	GenBank (MT645090); Aman et al. (2020)
		Iodophanus	*carneus*	(Pers.) Korf	FOP
		Ionopezia	*gerardii*	(Cooke) Van Vooren	FOP
		Mattirolomyces	*spinosus*	(Harkn.) Kovács, Trappe & Alsheikh	GenBank (MT649183); FOP; Aman et al. (2020)
		Pachyphlodes	*conglomerata*	(Berk. & Broome) Doweld	GenBank (HG797006)
		Paragalactinia	*michelii*	(Boud.) Dennis	GenBank (JN836749); Ashraf et al. (2012)
			succosa	(Berk.) Van Vooren	GenBank (JN588568); Ashraf and Khalid (2012)
			succosella	(Le Gal & Romagn.) Van Vooren	GenBank (KM199729); Jabeen et al. (2015a)
		Plicaria	*trachycarpa*	(Curr.) Boud.	FOP
		Peziza	*badiofusca*	(Boud.) Dennis	FOP
			cerea	Bull.	FOP
			micropus	Pers.	FOP
			pakistanica	(S. Ahmad) S. Ahmad	FOP
			repanda	Pers.	FOP
			vesiculosa	Pers.	FOP
			violacea	Pers.	FOP
	Pyronemataceae	*Terfezia*	*arenaria*	(Moris) Trappe	FOP
		Aleuria	*aurantia*	(Pers.) Fuckel	FOP
			boudieri	(Höhn.) J. Moravec	FOP
		Aleuria	*murreana*	S. Ahmad	FOP

Phylum/Order	Family	Genus	Species	Authority	Source
Pezizales	Pyronemataceae	*Byssonectria*	*fusispora*	(Berk.) Rogerson & Korf	FOP
		Cheilymenia	*granulata*	(Bull.) J. Moravec	FOP
			pulcherrima	(P. Crouan & H. Crouan) Boud.	FOP
			theleboloides	(Alb. & Schwein.) Boud.	FOP
		Geopora	*ahmadii*	Saba, T. Ashraf, Khalid & Pfister	GenBank (KY805996); Saba et al. (2019a)
			arenicola	(Lév.) Kers	FOP
			arenosa	(Fuckel) S. Ahmad	FOP
			cooperi	Harkn.	Ashraf and Khalid (2012)
			cooperi f. cooperi		GenBank (JN558642)
			foliacea	(Schaeff.) S. Ahmad	FOP
			pinyonensis	Flores-Rent. & Gehring	GenBank (MK583663)
			sumneriana	(Cooke ex W. Phillips) M. Torre,	GenBank (MN860070)
		Geopyxis	*alpina*	Höhn.	Khalid et al. (2000)
			majalis	(Fr.) Sacc.	FOP
		Humaria	*hemisphaerica*	(F.H. Wigg.) Fuckel	FOP
		Neottiella	*hetieri*	Boud.	FOP
		Octospora	*humosa*	(Fr.) Dennis	FOP
			plumbeoatra	(E.K. Cash) D.C. Pant & V.P. Tewari	FOP
			umbrina	(E.K. Cash) S. Ahmad	FOP
		Otidea	*alutacea*	(Pers.) Massee	GenBank (MN495937)
			leporina	(Batsch) Fuckel	FOP
		Pyronema	*omphalodes*	(Bull.) Fuckel	FOP
			domesticum	(Sowerby) Sacc.	GenBank (MN957610)
		Sepultariella	*semiimmersa*	(P. Karst.) Van Vooren, U. Lindem. & Healy	FOP
		Scutellinia	*scutellata*	(L.) Lambotte	FOP
		Trichophaea	*gregaria*	(Rehm) Boud.	FOP
			woolhopeia	(Cooke & W. Phillips) Boud.	FOP
	Sarcoscyphacea	*Kompsoscypha*	*waterstonii*	(Seaver) Pfister	FOP
	Sarcosomataceae	*Plectania*	*melastoma*	(Sowerby) Fuckel	FOP
		Sarcoscypha	*coccinea*	(Gray) Boud.	FOP
			occidentalis	(Schwein.) Sacc.	FOP
	Tuberaceae	*Tuber*	*puberulum*	Berk. & Broome	FOP
	Incertae sedis	*Coprotus*	*albidus*	(Boud.) Kimbr.	FOP
			dextrinoideus	Kimbr., Luck-Allen & Cain	FOP
			granuliformis	(P. Crouan & H. Crouan) Kimbr.	FOP
			leucopocillum	Kimbr., Luck-Allen & Cain	FOP
			ochraceus	(P. Crouan & H. Crouan) J. Moravec	FOP
			niveus	(Fuckel) Kimbr., Luck-Allen & Cain	FOP
			sexdecimsporus	(P. Crouan & H. Crouan) Kimbr. & Korf	FOP
Incertae sedis	Pulvinulaceae	*Pulvinula*	*orichalcea*	(Cooke) Rifai	FOP
	Tarzettaceae	*Tarzetta*	*bronca*	(Peck) Korf & J.K. Rogers	FOP
			catinus	(Holmsk.) Korf & J.K. Rogers	FOP
			cupularis	(L.) Lambotte	FOP

Table 2. Genus wise distribution in different ecoregions of Pakistan.

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Abortiporus	1	○	○	○	○	○	●	○	○	○	○	○	○	○	○	●
Acanthocystis	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Acanthofungus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Agaricus	31	●	○	○	○	●	●	●	○	○	○	○	○	○	●	●
Agrocybe	6	●	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Ahmadea	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Albatrellus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Aleuria	3	○	○	○	○	●	○	●	○	○	○	○	○	○	○	○
Aleurodiscus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Allophylaria	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Amanita	28	○	○	○	○	●	○	●	●	○	○	○	○	○	●	●
Amaropostia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Amphinema	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Amylosporus	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Amylostereum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Anomoloma	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Anthracophyllum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Antrodia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Antrodiella	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Aphelaria	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Apioperdon	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Aporium	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Armillaria	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Armillariella	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Arrhenia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Ascobolus	12	○	○	○	○	○	●	●	○	○	○	○	○	○	●	●
Ascodesmis	4	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Asterostroma	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Astraeus	1	●	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Athelia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Aureoboletus	1	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○
Aurificaria	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Auriscalpium	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Baeospora	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Battarrea	1	●	○	○	○	○	○	●	○	○	○	○	○	●	○	○
Bjerkandera	1	○	○	○	○	○	●	●	○	○	○	○	○	○	●	●
Bolbitius	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Boletopsis	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Boletus	8	○	○	○	○	●	●	○	○	○	○	○	○	○	●	●
Bondarzewia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Bovista	9	○	○	○	○	●	○	●	●	○	○	○	○	○	●	●
Bovistella	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Brevicellicium	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Britzelmayria	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Brunneoporus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Bryoperdon	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Butyriboletus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Byssomerulius	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Byssonectria	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Cabalodontia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Callistosporium	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Calloria	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Caloboletus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Calvatia	5	○	○	○	○	○	○	○	●	○	○	○	○	○	○	●
Calycina	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Cantharellus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	●
Cellulariella	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cerioporus	3	○	○	○	○	●	●	○	○	○	○	○	○	○	●	●
Ceriporia	3	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Chaetocalathus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Chalciporus	1	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Chamaemyces	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Cheilymenia	3	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Chlorencoelia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Chlorophyllum	4	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Chondrostereum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Chroogomphus	5	○	○	○	○	○	○	○	●	○	○	○	○	○	●	○
Cistella	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Clavaria	2	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Clavariadelphus	5	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Clavulina	4	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Clavulinopsis	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Climacodon	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Clitocella	2	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Clitocybe	7	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Clitocybula	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Clitopilus	5	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Collybia	3	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Collybiopsis	3	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Coltricia	3	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Colus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Coniophora	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Conocybe	9	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Coprinellus	8	●	○	○	○	○	●	●	○	○	○	○	○	○	○	●
Coprinopsis	6	○	○	○	○	○	●	●	○	○	○	○	○	○	●	○
Coprinus	2	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Coprotus	7	●	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Coriolopsis	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Coriolus	1	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Cortinarius	21	○	○	○	○	○	●	○	○	○	○	○	○	○	●	●
Craterellus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Crepidotus	4	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Crinipellis	2	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Crucibulum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Cudonia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cyanoboletus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Cyathicula	4	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Cyathus	3	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Cyclocybe	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Cystoderma	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Cystodermella	2	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○
Cystolepiota	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Cystostiptoporus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Cytidia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Daedalea	3	○	○	○	○	●	○	●	○	○	○	○	○	○	○	○
Daedaleopsis	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Daldinia	3	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Deconica	4	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Dendrocorticium	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Dendrothele	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Desarmillaria	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Descolea	2	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Dichostereum	2	○	○	○	○	●	○	●	○	○	○	○	○	○	○	○
Diplonaevia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Discina	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Disciseda	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Duportella	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Earliella	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Echinoderma	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Entoloma	9	○	○	○	●	○	○	●	○	○	○	○	○	○	●	○
Epithele	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Favolus	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Fistulina	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Flammulaster	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Flammulina	3	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Flavodon	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Fomes	4	○	○	○	○	●	●	●	○	○	○	○	○	○	●	●
Fomitiporia	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Fomitopsis	3	○	○	○	○	●	○	●	●	○	○	○	○	○	●	○
Funalia	3	○	○	○	○	○	○	●	●	○	○	○	○	○	○	●
Fuscoporia	4	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Galerina	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Ganoderma	8	○	○	○	○	●	●	●	○	○	○	○	○	○	●	●
Gastrosporium	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Geastrum	16	○	○	○	○	●	●	●	○	○	○	○	○	○	●	●
Geoglossum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Geopora	8	○	○	○	○	●	●	●	○	○	○	○	○	○	○	●
Geopyxis	2	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Gloeocystidiellum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Gloeophyllum	3	○	○	○	○	●	●	○	○	○	○	○	○	○	●	●
Gloeoporus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Gomphidius	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Gomphus	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Grammothele	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Gymnopilus	12	○	○	○	○	●	○	●	○	○	○	○	○	●	●	●
Gymnopus	9	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Gyrodon	1	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○
Gyrodontium	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Gyromitra	3	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hebeloma	7	○	○	○	○	○	○	●	●	○	○	○	○	○	●	○
Helvella	13	○	○	○	○	●	●	○	○	○	○	○	○	○	●	●
Henningsomyces	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Hericium	4	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Heterobasidion	4	○	○	○	○	●	○	○	●	○	○	○	○	○	●	●
Hexagonia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Hohenbuehelia	4	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Homophron	1	●	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Hortiboletus	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Humaria	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hyalorbilia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hyaloscypha	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Hydnellum	3	○	○	○	○	●	○	●	○	○	○	○	○	○	○	●
Hydnophlebia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Hydnoporia	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hydnum	2	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Hydropisphaera	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Hygrocybe	7	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hygrophorus	6	○	○	○	○	○	●	○	○	○	○	○	○	○	●	●
Hymenagaricus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Hymenochaete	9	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hymenopellis	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hymenoscyphus	5	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hyphodermella	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Hyphodontia	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Hypholoma	4	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Hypochnicium	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Hypsizygus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Incrucipulum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Infundibulicybe	3	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Inocutis	2	●	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Inocybe	30	○	○	○	○	●	●	○	○	○	○	○	○	○	●	●
Inonotus	7	●	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Inosperma	3	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Iodophanus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Ionopezia	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Irpex	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Irpiciporus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Itajahya	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Jahnoporus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Kompsoscypha	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Kuehneromyces	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Laccaria	6	○	○	○	○	●	○	○	●	○	○	○	○	○	●	○
Lachnellula	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Lachnocladium	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Lachnum	5	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Lactarius	20	○	○	○	○	●	●	○	●	○	○	○	○	○	●	○
Lactifluus	7	○	○	○	○	○	●	○	○	○	○	○	○	○	●	●
Lactocollybia	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Laetiporus	1	○	○	○	○	●	●	○	○	○	○	○	○	○	●	○
Langermannia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Lasiobelonium	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Lasiobolus	2	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Laxitextum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Leccinellum	2	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○
Leccinum	4	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Lentaria	3	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Lentinellus	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Lentinus	7	○	○	○	○	○	○	●	○	○	○	○	○	○	●	●

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Lenzites	2	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Leotia	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Lepiota	23	○	○	○	○	○	○	●	○	○	○	○	○	●	●	○
Lepista	4	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Leptonia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Leptoporus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Leucoagaricus	15	○	○	○	○	○	○	●○	○	○	○	○	○	○	●	●
Leucocoprinus	3	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Leucocybe	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Leucogyrophana	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Leucopaxillus	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Limacella	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Limacellopsis	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Lopharia	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Lycoperdon	14	○	○	○	○	●	●	●	○	○	○	○	○	○	●	●
Lyophyllum	2	●	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Lysurus	3	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Macrocybe	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Macrocystidia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Macrolepiota	4	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Mallocybe	2	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Marasmiellus	9	○	○	○	○	○	○	●	●	○	○	○	○	○	●	○
Marasmius	13	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Mattirolomyces	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Megacollybia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Melanogaster	1	○	○	○	○	○	○	○	●	○	○	○	○	○	○	○
Melanoleuca	5	○	○	○	○	●	○	●	●	○	○	○	○	○	○	●
Melanotus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Merismodes	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Micropsalliota	3	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Moellerodiscus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Montagnea	1	●	○	○	○	○	○	●	○	○	○	○	○	●	○	○
Morchella	7	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Multiclavula	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Mycena	7	○	○	○	○	●	●	○	○	○	○	○	○	○	●	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Mycenastrum	1	●	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Mycetinis	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Mycorrhaphium	1	○	○	○	○	●	○	●	○	○	○	○	○	○	○	○
Myriostoma	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Mythicomyces	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Naucoria	3	○	○	○	○	○	○	●	●	○	○	○	○	○	○	○
Neoalbatrellus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Neoboletus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Neolentinus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Neottiella	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Nothopanus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Octospora	3	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Odontia	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Omphalotus	1	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Onnia	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Orbilia	3	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Otidea	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Oxyporus	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Pachyphlodes	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Panaeolus	6	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Panellus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Panus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Paragalactinia	3	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Paralepista	1	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Parasola	9	●	○	○	○	○	○	●	○	○	○	○	○	○	●	●
Paxina	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Peniophora	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Peniophorella	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Perenniporia	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Perrotia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Peziza	7	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Phaeoclavulina	2	○	○	○	○	●	○	○	○	○	○	○	○	○	○	●
Phaeocollybia	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Phaeodaedalea	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Phaeolepiota	1	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Phaeolus	2	○	○	○	○	●	●	○	○	○	○	○	○	○	○	●
Phaeophlebiopsis	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Phallus	6	○	○	○	○	●	●	●	○	○	○	○	○	○	●	●
Phanerodontia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Phellinopsis	1	○	○	○	○	●	○	●	○	○	○	○	○	○	○	○
Phellinus	18	●	○	○	○	●	○	●	●	○	○	○	○	○	●	●
Phellodon	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Phellorinia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Phlebia	3	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Phlebiopsis	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Phloeomana	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Pholiota	8	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Phylloporia	3	○	○	○	○	●	○	●	○	○	○	○	○	○	○	●
Phylloporus	3	○	○	○	○	○	○	●	○	○	○	○	○	○	●	●
Picipes	2	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○
Pilatoporus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Pisolithus	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Pistillaria	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Plectania	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Pleurotus	8	●	○	○	○	○	○	●	●	○	○	○	○	○	●	●
Plicaria	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Plicatura	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Pluteus	11	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Podaxis	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Podoscypha	5	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Podosordaria	4	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Polyporellus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Polyporus	3	○	○	○	○	○	●	●	○	○	○	○	○	○	●	●
Poria	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Porodaedalea	2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Poronia	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Porostereum	1	○	○	○	○	●	○	●	○	○	○	○	○	○	●	●
Porphyrellus	1	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Postia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Protostropharia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Protubera	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Psathyrella	13	○	○	○	○	○	○	●	○	○	○	○	○	○	●	●
Pseudoboletus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Pseudoinonotus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Pseudolaccaria	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Pseudomerulius	1	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Pseudosperma	7	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Psilocybe	2	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Pulvinula	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Punjabia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Pycnoporellus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Pycnoporus	2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Pyrenopeziza	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Pyrofomes	2	●	○	○	○	○	○	○	○	○	○	○	●	○	○	○
Pyronema	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Ramaria	12	○	○	○	○	●	●	○	○	○	○	○	○	○	●	●
Ranadivia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Resinoporia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Resupinatus	2	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Rhizochaete	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Rhizopogon	1	○	○	○	○	○	○	○	●	○	○	○	○	○	●	●
Rhodocollybia	4	○	○	○	○	○	○	○	●	○	○	○	○	○	●	○
Rhodocybe	2	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Rhodofomes	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Rigidoporus	5	○	○	○	○	●	●	●	○	○	○	○	○	○	○	●
Rubroboletus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Russula	52	○	○	○	○	●	●	●	●	○	○	○	○	○	●	●
Rutrstroemia	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Saccobolus	6	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Sagaranella	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Saproamanita	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Sarcodon	1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Sarcodontia	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Sarcoscypha	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Schizophyllum	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Schizopora	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Schizostoma	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Scleroderma	10	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Scopuloides	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Scutellinia	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Scytinostroma	2	○	○	○	○	●	○	●	○	○	○	○	○	○	○	○
Secotium	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Sepultariella	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Serpula	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Simocybe	1	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○
Sparassis	3	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Sphaerobolus	2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Steccherinum	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Stereum	8	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Stramatoscypha	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Strobilomyces	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Strobilurus	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Stropharia	3	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Suillellus	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Suillus	14	○	○	○	○	●	●	○	●	○	○	○	○	○	●	○
Tapesia	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Tapinella	2	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Tarzetta	3	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Tatraea	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Tephrocybe	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Terfezia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Termitomyces	10	●	○	○	○	○	○	●	○	○	○	○	○	○	●	●
Thelebolus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Thelephora	9	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Tomentella	4	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Tomophagus	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Trametes	15	●	○	○	○	●	●	●	○	○	○	○	○	○	●	●
Trametopsis	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Trichaptum	2	●	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Trichoderma	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○

Genus	Total species	BXW	EAMCF	IRM	IVD	HSTPF	KWTP	NWTSF	NWHASM	ROK	RNPSD	SINSD	SRAM	TD	WHBF	WHSACF
Trichoglossum	3	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Tricholoma	8	○	○	○	○	○	●	○	○	○	○	○	○	○	●	○
Tricholomopsis	5	○	○	○	○	○	●	○	●	○	○	○	○	○	●	○
Trichophaea	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Trogia	1	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Tropicoporus	1	○	○	○	○	●	○	●	○	○	○	○	○	○	●	○
Truncospora	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○
Tubaria	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Tuber	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Tulostoma	25	●	○	○	○	●	●	●	○	○	○	○	○	○	○	●
Turbinellus	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Tylopilus	3	○	○	○	○	○	●	○	○	○	○	○	○	○	●	●
Tyromyces	2	○	○	○	○	●	○	○	○	○	○	○	○	○	●	○
Velutarina	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Verpa	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Volvariella	6	○	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Volvopluteus	2	●	○	○	○	○	○	●	○	○	○	○	○	○	●	○
Xanthagaricus	3	●	○	○	○	○	○	●	○	○	○	○	○	○	○	●
Xanthoconium	3	○	○	○	○	●	●	○	●	○	○	○	○	○	○	○
Xanthoporia	1	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○
Xerocomus	4	○	○	○	○	○	●	●	○	○	○	○	○	○	●	○
Xeromphalina	1	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○
Xerula	2	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Xylaria	5	○	○	○	○	●	○	●	○	○	○	○	○	○	○	○
Xylobolus	1	○	○	○	○	●	○	○	○	○	○	○	○	○	●	●
Xylodon	1	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
Xylosphaera	1	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○
Zhuliangomyces	2	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○

Where, **BXW** = Baluchistan xeric woodlands, **EAMCF** = East Afghan montane conifer forests, **IRM** = Indus River Delta Arabian sea mangroves, **IVD** = Indus valley desert, **HSTPF** = Himalayan subtropical pine forests, **KWTP** = Karakorem west Tibetan plateau alpine steppe, **NWTSF** = North-western thorn scrub forest, **NWHASM** = North-western Himalayan alpine scrub & meadows, **RNPSD** = Registan north Pakistan sandy desert, **ROK** = Rann of Kutch seasonal marsh, **SINSD** = South Iran Nubo-Sindian desert & semi-desert, **SRAM** = Sulaiman range Alpine meadows, **WHBF** = Western Himalayan broadleaf forests, **WHSACF** = Western Himalayan subalpine conifer forests, **TD** = Thar Desert.

Discussion

The compendium presented in Table 1 gives an overview of the macrofungal diversity of Pakistan known to date. It largely reposes on the checklist by Ahmad et al. (1997; 866 entries) published over two decades ago and its recent update (Khalid, *in press*), as well as taxa recently described with the use of molecular data, for example, *Russula foetenoides* (Razaq et al. 2014), *Leucoagaricus lahorensis* (Qasim et al. 2015a), *Tulsotoma ahmadii* (Hussain et al. 2015b), *Phaeocollybia pakistanica* (Khan et al. 2016a), *Descolea quercina* (Khan et al. 2017a), *Amanita griseofusca* (Kiran et al. 2018), *Leucoagaricus brunneus* (Ullah et al. 2019), *Ahmadea dalanensis* (Aman et al. 2020) etc. Numerous edible mushrooms naturally occur in Pakistan including *Agaricus bisporus*, *Boletus edulis*, *Termitomyces umkowaan*, *Macrocybe gigantea*, *Morchella esculenta* (morels), *Ahmadea dalanensis* (truffles), *Pleurotus cystidiosus*, *Marasmius oreades*, *Phellorinia herculeana*, *Cantharellus cinereus* (chanterelle), *Coprinus comatus* and more. Siddiqui et al. (2020) worked on the cultivation potential of two wild indigenous species of *Agaricus*, i.e. *A. bisporus* and *A. subrufescens* and obtained promising results for spawn production locally. In the future, more edible mushrooms can be worked on for their possible cultivation and commercialisation prospects.

We recorded 1,293 species belonging to 411 genera, 115 families and 24 orders. For comparison, Vaco-Palacios and Franco-Molano (2013) listed 1,239 macrofungal species from Colombia. Flores et al. (2012) reported 315 taxa, 163 genera and 20 orders from Guatemala. Kinge et al. (2020) recently presented an elaborate checklist of macrofungi in South Africa listing 1,008 species, 251 genera and 72 families. For comparison with a well-studied area, 3,173 species have been reported from Quebec (mycoquébec.org). Approximately 20,000 species of macrofungi are known worldwide (Hawksworth 2001). Unsurprisingly, since Agaricales is the largest order of macrofungi (Money 2016), it is by far the most commonly represented order with 47% species in the present taxonomic list followed by Polyporales (11%), Russulales (9%) and Pezizales (8%).

The highest number of taxa was recorded in the western Himalayan broadleaf forests ecoregion, which belongs to the temperate broadleaf and mixed forest biome and has been reported to be the richest in central China and eastern North America (Zhao et al. 1990; Martin et al. 1993). The second highest diversity was found in the north-western thorn scrub forests, which are categorised under deserts and xeric shrublands. This thorn scrub is considered as a degraded form of tropical dry forests (e.g. Champion and Seth 1968; Puri et al. 1989). This ecoregion includes semi-arid to arid climatic zones and a mean annual rainfall of less than 750 mm and a temperature range of 45 degrees or more in summers to temperatures dropping below freezing point in winters. Furthermore, ecoregions in tropical and subtropical coniferous forests and temperate coniferous forest biomes also show good macrofungal taxa representation. The ecoregion of western Himalayan subalpine conifer forests plays an important ecological role to vanguard the alpine meadows to the north. For instance, many Himalayan birds and mammals migrate seasonally between the steep mountain

slopes, relying on adjacent habitats when the original ones are disturbed. Likewise, large-scale collection of morel mushrooms (*Morchella spp.*) from this ecoregion by local people for export overlaps with the breeding season of many pheasants and some mammals. Therefore, maintaining the biodiversity composition and ecological processes within this geologically young, highest mountain range on Earth requires particular conservation policies for this unique ecoregion (Wikramanayake et al. 2002). Finally, the ecoregions of flooded grasslands and savannahs, mangroves and montane grasslands and shrublands have either less than five percent or no representation. So, clearly there are missing data due to very limited exploration in several regions.

Although the data presented here will be useful to taxonomists, ecologists and conservation biologists, conclusive trends cannot be drawn as there are gaps in data due to extensive sampling in a few ecoregions, whereas other areas have been either neglected or unexplored. Therefore, the unexplored ecoregions of Pakistan need to be sampled extensively to give a full picture of the fungal diversity and endemism therein. Many countries and regions around the world have identified and listed endemic species, including the United States (Stein 2002), Russia (Griffin 1999), the Tuscan Region in Italy (Foggi et al. 2014) and New Caledonia (Wulff et al. 2013). The International Union for Conservation of Nature (IUCN) recently published a report on endemic threatened species on the Red List for each country (IUCN 2019). Redhead (1997) listed rare macrofungi of British Columbia, Canada, for each ecoregion. More recently, Enns et al. (2020) generated a list of endemic species, including a few fungal species as well, highlighting the status of target species for conservation.

In conclusion, this study provides a comprehensive list of macrofungi recorded in Pakistan as of the year 2020 and their known distribution by ecoregions. The otherwise scattered data have now been arranged and are available to be utilised by mycologists and other scientists as well as by amateur citizens. Most importantly, it can serve as a baseline information for further conservation studies and policy-making. Furthermore, these data also highlight the need for more sampling from less sampled areas like Sindh and Baluchistan Provinces. Our next step is to develop an online portal for fungi of Pakistan, where revisions of the current compendium can be done and new reports can be continuously added.

References

Adamčík S, Looney B, Caboň M, Jančovičová S, Adamčíková K, Avis PG, Barajas M, Bhatt RP, Corrales A, Das K, Hampe F, Ghosh A, Gates G, Kälviäinen V, Khalid AN, Kiran M, De Lange R, Lee H, Lim YW, Kong A, Manz C, Ovrebo C, Saba M, Taipale T, Verbeken A, Wisitrassameewong K, Buyck B (2019) The quest for a globally comprehensible *Russula* language. Fungal Diversity 99(1): 369–449. https://doi.org/10.1007/s13225-019-00437-2

Ahmad I, Khurshid R, Ziaullah, Bibi A, Azhar N, Islam M, Ashraf S, Hussain S, Faiz AH, Khalid AN, Manshad K (2019) First report of *Russula brunneopurpurea* from State of Azad Jammu and Kashmir, Pakistan using internal transcribed spacer technique. Sylwan 163(9): 113–133.

Ahmad S, Iqbal S, Khalid AN (1997) Fungi of Pakistan. Sultan Ahmad Mycological Society of Pakistan. Lahore, 248 pp.

Ali M, Khan J, Bashir H, Naizi AR, Sher H, Khalid AN (2020) *Infundibulicybe macrospora* sp. nov., a new and noteworthy species from Himalayan moist temperate forests of Pakistan. Phytotaxa 452(4): 268–277. https://doi.org/10.11646/phytotaxa.452.4.2

Aman N, Khalid AN, Moncalvo JM (2020) *Ahmadea dalanensis* gen. and sp. nov., an edible truffle from Pakistan. Studies in Fungi 5(1): 452–461. https://doi.org/10.5943/sif/5/1/26

ArcGis (2021) WWF Terrestrial Ecoregions Of The World (Biomes). https://www.arcgis.com/apps/View/index.html?appid=d60ec415febb4874ac5e0960a6a2e448

Ashraf T, Khalid AN (2012) New records of Pezizales from Pakistan. Mycotaxon 119(1): 301–306. https://doi.org/10.5248/119.301

Ashraf T, Hanif M, Khalid AN (2012) *Peziza michelii* and its ectomycorrhizae with *Alnus nitida* (Betulaceae) from Pakistan. Mycotaxon 120(1): 181–188. https://doi.org/10.5248/120.181

Badshah H, Ali B, Shah SA, Alam MM, Aly HI, Mumtaz AS (2018) First record of *Morchella pulchella* from Pakistan. Mycotaxon 133(1): 201–207. https://doi.org/10.5248/133.201

Bailey RG (1998) Ecoregions: The Ecosystem Geography of Oceans and Continents. New York: Springer-Verlag, 180 pp.

Bashir H, Hussain S, Khalid AN, Niazi AR, Parra LA, Callac P (2018) First report of *Agaricus* sect. *Brunneopicti* from Pakistan with descriptions of two new species. Phytotaxa 357(3): 167–178. https://doi.org/10.11646/phytotaxa.357.3.1

Bashir H, Usman M, Khalid AN (2020a) *Lepiota cholistanensis* a new species of *Lepiota* (Agaricaceae: Basidiomycota) from Cholistan desert, Pakistan. Phytotaxa 455(4): e273. https://doi.org/10.11646/phytotaxa.455.4.4

Bashir H, Jabeen S, Bashir H, Khalid AN (2020b) *Gymnopilus dunensis*, a new species from Punjab Province, Pakistan. Phytotaxa 428(1): 051–059. https://doi.org/10.11646/phytotaxa.428.1.5

Bisby GR, Ainsworth GC (1943) The numbers of fungi. Transactions of the British Mycological Society 26(1–2): 16–19. https://doi.org/10.1016/S0007-1536(43)80005-X

Blackwell M (2011) The Fungi: 1, 2, 3 . . . 5.1 million species? American Journal of Botany 98(3): 426–438. https://doi.org/10.3732/ajb.1000298

Butler EJ, Bisby GR (1931) The fungi of India. Imperial Council of Agriculture Research. Indian Science Monograph 18: e237.

Champion HG, Seth SK (1968) A revised forest types of India. Manager of Publications, Government of India, Delhi.

Cheek M, Lughadha EN, Kirk P, Lindon H, Carretero J, Looney B, Douglas B, Haelewaters D, Gaya E, Llewellyn T, Ainsworth AM, Gafforov Y, Hyde K, Crous P, Hughes B, Walker BE, Forzza RC, Wong KM, Nishkanen T (2020) New scientific discoveries: Plants and fungi. Plants People Planet. 2(5): 371–388. https://doi.org/10.1002/ppp3.10148

Chen J, Parra LA, Kesel AD, Khalid AN, Qasim T, Ashraf A, Bahkal AH, Hyde KD, Zhao R, Callac P (2016) Inter- and intra-specific diversity in *Agaricus endoxanthus* and allied species reveals a new taxon, *A. punjabensis*. Phytotaxa 252(1): 1–16. https://doi.org/10.11646/phytotaxa.252.1.1

Crous PW, Wingfield MJ, Lombard L, Roets F, Swart WJ, Alvarado P, Carnegie AJ, Moreno G, Luangsa-ard J, Thangavel R, Alexandrova AV, Baseia IG, Bellanger JM, Bessette AE, Bessette

AR, Peña-Lastra SDL, Garcia D, Gene J, Pham THG, Heykoop M, Malysheva E, Malysheva V, Martin MP, Morozova OV, Noisripoom, Overton BE, Rea AE, Sewall BJ, Smith ME, Smyth CW, Tasanathai K, Visagie CM, Adamčík S, Alves A, Andrade JP, Aninat MJ, Araújo RVB, Bordallo JJ, Boufleur T, Baroncelli R, Barreto RW, Bolin J, Cabero J, Cabon M, Cafà G, Caffot MLH, Cai L, Carlavilla JR, Chávez R, de Castro RRL, Delgat L, Ferreira BW, Figueiredo CN, Liu F, Fournier J, Galli-Terasawa LV, Gil-Durán C, Glienke C, Gonçalves MFM, Gryta H, Guarro J, Himaman W, Hywel-Jones N, Iturrieta-González I, Ivanushkina NE, Jargeat P, Khalid AN, Khan J, Kiran M, Kiss L, Kochkina GA, Kolařík M, Kubátová A, Lodge DJ, Loizides M, Luque D, Manjón JL, Marbach PAS, Massola Jr NS, Mata M, Miller AN, Mongkolsamrit S, Moreau PA, Morte A, Mujic A, Navarro-Ródenas A, Németh MZ, Nóbrega TF, Nováková A, Olariaga I, Rodríguez A, Requejo O, Rodrigues ACM, Rong IH, Roux J, Seifert KA, Švec K, Tanchaud P, Tanney JB, Terasawa F, Thanakitpipattana D, Torres-Garcia D, Vaca I, Vaghefi N, van Iperen AL, Vasilenko OV, Verbeken A, Yilmaz N, Zamora JC, Zapata M, Jurjević Ž, Groenewald JZ (2019) Fungal Planet description sheets: 951–1041 Persoonia 43: 223–425. https://doi.org/10.3767/persoonia.2019.43.06

de Laubenfels DJ (1975) Mapping the World's Vegetation: Regionalization of Formations and Flora. Syracuse University Press, Syracuse (NY).

Dinerstein E, Olson D, Joshi A, Vynne C, Burgess ND, Wikramanayake E, Hahn N, Palminteri S, Hedao P, Noss R, Hansen M, Locke H, Ellis EC, Jones B, Barber CV, Hayes R, Kormos C, Martin V, Crist E, Sechrest W, Price L, Baillie JEM, Weeden D, Suckling K, Davis C, Sizer N, Moore R, Thau D, Birch T, Potapov P, Turubanova S, Tyukavina A, de Souza N, Pintea L, Brito JC, Llewellyn OA, Miller AG, Patzelt A, Ghazanfar SA, Timberlake J, Klöser H, Shennan-Farpón Y, Kindt R, Lillesø JB, van Breugel P, Graudal L, Voge M, Al-Shammari KF, Saleem M (2017) An ecoregion-based approach to protecting half the terrestrial realm. Bioscience 67(6): 534–545. https://doi.org/10.1093/biosci/bix014

Dubois G, Bastin L, Battistella L, Bertzky B, Conti M, Delli G, Graziano M, Mandrici A, Martínez-López J, Saura S (2018) DOPA Explorer 2.0: A web-based tool assessing all large protected areas in support to conservation policies. 5th European Congress of Conservation Biology. https://doi.org/10.17011/conference/eccb2018/108141

Enns A, Kraus D, Hebb A (2020) Ours to save: the distribution, status and conservation needs of Canada's endemic species. NatureServe Canada and Nature Conservancy of Canada.

Farooqi A, Aqdas F, Niazi AR, Jabeen S, Khalid AN (2017) *Inocybe ahmadii* sp. nov. and a new record of *I. leptocystis* from Pakistan. Mycotaxon 132(2): 257–269. https://doi.org/10.5248/132.257

Fiaz M, Jabeen S, Imran A, Ahmad H, Khalid AN (2014) Extension of *Macrolepiota* distribution to the montane temperate forests of Pakistan. Mycotaxon 129(1): 197–208. https://doi.org/10.5248/129.197

Flores AR, Comandini O, Rinaldi AC (2012) A preliminary checklist of macrofungi of Guatemala, with notes on edibility and traditional knowledge. Mycosphere. Journal of Fungal Biology 3(1): 1–21. https://doi.org/10.5943/mycosphere/3/1/1

Foggi B, Viciani D, Baldini RM, Carta A, Guidi T (2014) Conservation assessment of the endemic plants of the Tuscan Archipelago, Italy. Oryx 49 (1): 118–126. https://doi.org/10.1017/S0030605313000288

Gardezi SRA (2003) Mushrooms of Kashmir VIII. Sarhad Journal of Agriculture 19(2): 245–255. https://doi.org/10.3923/ajps.2003.804.810

Ge ZW, Qasim T, Yang ZL, Nawaz R, Khalid AN, Vellinga EC (2015) Four new species in *Leucoagaricus* (Agaricaceae, Basidiomycetes) from Asia. Mycologia 107(5): 1033–1044. https://doi.org/10.3852/14-351

GenBank (2020, 2021) GenBank Overview. www.ncbi.nlm.nih.gov/Genbank

Gosz JR (1991) Fundamental ecological characteristics of landscape boundaries. In: Holland MM, Risser PG, Naiman RJ (Eds) Ecotones. Chapman and Hall, New York, 8–30. https://doi.org/10.1007/978-1-4615-9686-8_2

Griffin PC (1999) Endangered species diversity 'hot spots' in Russia and centers of endemism. Biodiversity and Conservation 8(8): 497–511. https://doi.org/10.1023/A:1008837023242

Haelewaters D, Dima B, Abbas II, Abdel-Hafiz, Mohamed A, Abdel-Wahab, Saamr RAE, Acar I, Aguirre-Acosta E, Aime C, Aldemir S, Ali M, Ayala-Vásquez O, Bakhit MS, Bashir H, Battistin E, Bendiksen E, Castro-Rivera R, Çolak OF, Kesel AD, de la Fuente JI, Dizkırıcı A, Hussain S, Jansen GM, Kaygusuz O, Khalid AN, Khan J, Kiyashko AA, Larsson E, Martínez-González CR, Morozova OV, Niazi AR, Noordeloos ME, Pham THG, Popov ES, Psurtseva NV, Afshan NS, Christe P, Fiaz M, Glaizot O, Liu J, Majeed J, Markotter W, Nagy A, Nawaz H, Papp V, Péter A, Pfliegler WP, Qasim T, Riaz M, Sándor AD, Szentiványi T, Voglmayr H, Yousaf N, Krisai-Greilhuber I (2020) Fungal Systematics and Evolution: FUSE 6. Sydowia 72: 171–296.

Hanif M, Khalid AN (2013) Intraspecific rDNA-ITS polymorphism within *Clavariadelphus subfastigiatus* (basidiomycota: Gomphoid-phalloid clade) from Pakistan. International Journal of Agriculture and Biology 15: 465–471.

Hanif M, Khalid AN, Exeter RL (2014) *Clavariadelphus pakistanicus* sp. nov., a new club fungus (Basidiomycota: Gomphales) from Himalayan moist temperate forests of Pakistan. Canadian Journal of Botany 92(7): 471–476. https://doi.org/10.1139/cjb-2013-0073

Hanif M, Khalid AN, Exeter RL (2019) *Ramaria flavescentoides* sp. nov. with clamped basidia from Pakistan. Mycotaxon 134(2): 399–406. https://doi.org/10.5248/134.399

Hawksworth D (1991) The fungal dimension of biodiversity: Magnitude, significance, and conservation. Mycological Research 95(6): 641–655. https://doi.org/10.1016/S0953-7562(09)80810-1

Hawksworth DL (2001) Mushrooms: The extent of the unexplored potential. International Journal of Medicinal Mushrooms 3(4): 333–337. https://doi.org/10.1615/IntJMedMushr.v3.i4.50

Hawksworth DL, Lucking R (2017) Fungal diversity revisited: 2.2 to 3.8 million species. Microbiology Spectrum 5(4): 1–14. https://doi.org/10.1128/microbiolspec.FUNK-0052-2016

Hernández-Restrepo M, Schumacher RK, Wingfield MJ, Ahmad I, Cai L, Duong TA, Edwards J, Gené J, Groenewald JZ, Jabeen S, Khalid AN, Lombard L, Madrid H, Marin-Felix Y, Marincowitz S, Miller AN, Rajeshkumar KC, Rashid A, Sarwar S, Stchigel AM, Taylor PWJ, Zhou N, Crous PW (2016) Fungal Systematics and Evolution: FUSE 2. Sydowia 68: 193–230.

Hibbett DS, Pine EM, Langer E, Langer G, Donoghue MJ (1997) Evolution of gilled mushrooms and puffballs inferred from ribosomal DNA sequences. Proceedings of the National Academy of Sciences of the United States of America 94(22): 12002–12006. https://doi.org/10.1073/pnas.94.22.12002

Holdridge LR (1967) Life Zone Ecology. Tropical Science Center, San Jose, Costa Rica, 51 pp.

Hussain S, Sher H (2019) Study in *Agaricus* section Minores in Pakistan with the description of two new species. Mycological Progress 2019(18): 795–804. https://doi.org/10.1007/s11557-019-01493-3

Hussain S, Afshan NS, Ahmad H, Khalid AN (2015a) New report of the edible mushroom *Pleurotus cystidiosus* from Pakistan. Asian Journal of Mycology 24: 23–30.

Hussain S, Yousaf N, Afshan NS, Niazi AR, Ahmad H, Khalid AN (2015b) *Tulostoma ahmadii* sp. nov. and *T. squamosum* from Pakistan. Turkish Journal of Botany 40(2): 218–225. https://doi.org/10.3906/bot-1501-9

Hussain S, Afshan NS, Ahmad A, Khalid AN (2015c) New report of edible mushroom, *Termitomyces umkowaan* from Pakistan. Sylwan 159(6): 185–197.

Hussain S, Afshan NS, Ahmad H (2016) First record of *Parasola lilatincta* from Pakistan. Mycotaxon 131(2): 316–322. https://doi.org/10.5248/131.317

Hussain S, Afshan NS, Habib A, Khalid AN, Niazi AR (2017) *Parasola malakandensis* sp. nov. (Psathyrellaceae; Basidiomycota) from Malakand. Pakistan Mycoscience 58(2): 69–76. https://doi.org/10.1016/j.myc.2016.09.002

Hussain S, Usman M, Afshan NS, Ahmad H, Khan J, Khalid AN (2018a) The genus *Coprinellus* (Basidiomycota; Agaricales) in Pakistan with the description of four new species. MycoKeys 39: 41–61. https://doi.org/10.3897/mycokeys.39.26743

Hussain S, Jabeen S, Khalid AN, Afshan NS, Ahmad H, Sher H, Pfister DH (2018b) Underexplored regions of Pakistan yield five new species of *Leucoagaricus.* Mycologia 110(2): 387–400. https://doi.org/10.1080/00275514.2018.1439651

Hussain S, Afshan NS, Ahmad H, Sher H, Khalid AN (2018c) *Xanthagaricus pakistanicus* sp. nov. (Agaricaceae), the first report of the genus from Pakistan. Turkish Journal of Botany 42: 123–133. https://doi.org/10.3906/bot-1705-21

Hussain S, Habib A, Ullah S, Afshan NS, Pfister DH, Sher H, Haider A, Khalid AN (2018d) The genus *Parasola* in Pakistan with the description of two new species. Mycokeys 30: 41–60. http://doi.org/10.3897/mycokeys.30.21430

Ilyas S, Razaq A, Khalid AN (2013a) *Inocybe nitidiuscula* and its ectomycorrhizae with *Alnus nitida* from Galyat, Pakistan. Mycotaxon 124(1): 247–254. https://doi.org/10.5248/124.247

Ilyas S, Razaq A, Khalid AN (2013b) Molecular investigations to determine the ectomycorrhizal habit of *Lactarius sanguifluus* associated with coniferous and deciduous vegetation of Galyat, Khyber Pakhtunkhwa, Pakistan. International Journal of Agriculture and Biology 15(5): 857–863. http://www.fspublishers.org/html_issue.php?i_id=3146

Index Fungorum (2021) Index Fungorum. http://www.indexfungorum.org/names/names.asp

Iqbal SH, Kasuya T, Khalid AN, Niazi AR (2006) *Lysurus pakistanicus*, a new species of Phallales from Pakistan. Mycotaxon 98: 163–168. http://www.mycotaxon.com/vol/abstracts/98/98-163.html

Ishaq M, Fiaz M, Naseer A, Khalid AN (2019a) *Amanita subjunquillea* and its ectomycorrhizal association, reported as new for Pakistan. Mycotaxon 134(3): 413–423. https://doi.org/10.5248/134.413

Ishaq M, Khan MB, Ullah S, Fiaz M, Khalid AN (2019b) *Infundibulicybe kotanensis* sp. nov. (Tricholomataceae), a new species from Buner, Pakistan. Phytotaxa 418(2): 195–202. https://doi.org/10.11646/phytotaxa.418.2.4

IUCN (2019) IUCN Red List of Threatened Species. https://www.iucnredlist.org/

Izhar A, Bashir H, Khalid AN (2019) A new species of *Conocybe* (Bolbitaceae) from Punjab, Pakistan. Phytotaxa 402(5): 251–258. https://doi.org/10.11646/phytotaxa.402.5.4

Izhar A, Khalid AN, Bashir H (2020) *Termitomyces sheikhupurensis* sp. nov. (Lyophyllaceae, Agaricales) from Pakistan, evidence from morphology and DNA sequences data. Turkish Journal of Botany 2020(44): 694–704. https://doi.org/10.3906/bot-2003-51

Jabeen S, Khalid AN (2020) *Pseudosperma flavorimosum* sp. nov. from Pakistan. Mycotaxon 135(1): 183–193. https://doi.org/10.5248/135.183

Jabeen S, Ashraf T, Khalid AN (2015a) *Peziza succosella* and its ectomycorrhiza associated with *Cedrus deodara* from Himalayan moist temperate forests of Pakistan. Mycotaxon 130(2): 455–464. https://doi.org/10.5248/130.455

Jabeen S, Fiaz M, Saba M, Ahmad H, Khalid AN (2015b) Molecular phylogeny and morphological characterization of *Russula livescens* and its ectomycorrhiza from mixed coniferous forests of Pakistan. Asian Journal of Mycology 24: 145–154. https://www.zobodat.at/pdf/OestZPilz_24_0145-0154.pdf

Jabeen S, Ahmad I, Rashid A, Khalid AN (2016a) *Inocybe Kohistanensis*, a new species from Swat, Pakistan. Turkish Journal of Botany 40: 312–318. https://doi.org/10.3906/bot-1501-17

Jabeen S, Niazi AR, Khalid AN (2016b) First record of *Russula anthracina* and its ectomycorrhiza from South Asia. Mycotaxon 131(1): 33–44. https://doi.org/10.5248/131.31

Jabeen S, Niazi AN, Khalid AN (2017a) *Russula brunneopurpurea* sp. nov. and its ectomycorrhiza from Pakistan. Mycosphere: Journal of Fungal Biology 8(8): 1059–1069. https://doi.org/10.5943/mycosphere/8/8/7

Jabeen S, Razaq A, Niazi AR, Ahmad I, Grebenc T, Khalid AN (2017b) *Russula ahmadii*, a new species in section Ingratae and its ectomycorrhiza from coniferous forests of Pakistan. Phytotaxa 321(3): 241–253. https://doi.org/10.11646/phytotaxa.321.3.2

Jabeen S, Kiran M, Ullah S, Wilson AW, Mueller GM, Fiaz M, Khalid AN (2017c) *Amanita glarea*, a new species in section Vaginatae from Pakistan. Phytotaxa 306(2): 135–145. https://doi.org/10.11646/phytotaxa.306.2.3

Jabeen S, Kiran M, Khan J, Ahmad I, Ahmad H, Sher H, Khalid AN (2019) *Amanita ahmadii*, a new species of *Amanita* subgenus *Amanitina* section Validae from Pakistan. MycoKeys 56: 81–99. https://doi.org/10.3897/mycokeys.56.31819

Jabeen S, Waseem B, Tuba, Hamid M, Yasmeen A (2020a) First record of *Leucoagaricus nivalis* from Pakistan. Bangladesh Journal of Plant Taxonomy 27(2): 453–459. https://doi.org/10.3329/bjpt.v27i2.50684

Jabeen S, Naseer A, Khalid AN (2020b) *Russula rubricolor* sp. nov. from Himalayan forests of Pakistan. Mycotaxon 135(4): 765–776. https://doi.org/10.5248/135.765

Kamran M, Jabeen S (2020) *Coprinellus ovatus* sp. nov. from Pakistan. Mycotaxon 135(2): 321–332. https://doi.org/10.5248/135.321

Khalid AN (In press) Annotated checklist of Macro-fungi of Pakistan published from 1998-2020.

Khalid AN, Hanif M (2017) *Thelephora iqbalii* sp. nov. from the Himalayan moist temperate forests of Pakistan. Mycotaxon 132(4): 943–950. https://doi.org/10.5248/132.943

Khalid AN, Iqbal SH (2004) *Calvatia ahmadii* sp. nov. from Pakistan. Pakistan Journal of Botany 36(3): 669–671. http://www.pakbs.org/pjbot/PDFs/36(3)/PJB36(3)669.pdf

Khalid AN, Qadeer N, Iqbal SH (2000) Addition to the discomycetes of Pakistan. Pakistan Journal of Botany 32(1): 27–34. http://www.pakbs.org/pjbot/PDFs/32(1)/PJB32(1)05.pdf

Khan J, Sher H (2016c) *Lactifluus volemus*: An addition to the fungi of Pakistan. International Journal of Agriculture and Biology 18(6): 1095–1097. https://doi.org/10.17957/IJAB/15.0214

Khan J, Sher H, Khalid AN (2016a) *Phaeocollybia pakistanica* sp. nov., the first representative of the genus from Pakistan. Mycotaxon 131(04): 889–896. https://doi.org/10.5248/131.889

Khan J, Sher H, Khalid AN (2016b) *Abortiporus biennis*: The third record of this fungus and a new genus name for the Pakistan fungi. Asian Journal of Mycology 25: 19–22.

Khan J, Sher H, Naseer A, Khalid AN (2017a) *Descolea quercina (*Bolibitaceae), a new species from moist temperate forests in Pakistan. MycoKeys 27: 65–76. https://doi.org/10.3897/mycokeys.27.14730

Khan J, Kiran M, Jabeen S, Sher H, Khalid AN (2017b) *Gymnopilus penetrans* and *G. swaticus* sp. nov. (Agaricomycota: Hymenogastraceae); a new record and a new species from northwest Pakistan. Phytotaxa 312(1): 060–070. https://doi.org/10.11646/phytotaxa.311.2.5

Khan J, Sher H, Bussmann RW, Hart R, Khalid AN (2018) *Albatrellus roseus* sp. nov. (Albatrellaceae; Basidiomycota), the first representative of the genus from Pakistan. Mycoscience 59(1): 12–17. https://doi.org/10.1016/j.myc.2017.07.002

Khan MB, Ishaq M, Kiran M, Fiaz M, Khalid AN (2019) *Stropharia atroferruginea* (Agaricales, Strophariaceae), a new species from Battagram District, Pakistan. Phytotaxa 409(2): 83–92. https://doi.org/10.11646/phytotaxa.409.2.4

Khan J, Sher H, Hussain S, Khalid AN (2020) First report of *Hericium cirrhatum* from Pakistan. Mycotaxon 135(4): 845–852. https://doi.org/10.5248/135.845

Kinge TR, Goldman G, Jacobs A, Ndiritu GG, Gryzenhout M (2020) A first checklist of macrofungi of South Africa. MycoKeys 63: 1–48. https://doi.org/10.3897/mycokeys.63.36566

Kiran M, Khan J, Naseer A, Sher H, Khalid AN (2017) *Amanita pallidorosea* in Pakistan and its ectomycorrhizal association with Quercus oblongata. Mycotaxon 132(4): 799–811. https://doi.org/10.5248/132.799

Kiran M, Khan J, Sher H, Pfister DH, Khalid AN (2018) *Amanita griseofusca*: A new species of *Amanita* in section Vaginatae from Malam Jabba, Swat, Pakistan. Phytotaxa 364(2): 181–192. https://doi.org/10.11646/phytotaxa.364.2.5

Kiran M, Sattar A, Zamir K, Haelewaters D, Khalid AN (2020) Additions to the genus *Chroogomphus* (Boletales, Gomphidiaceae) from Pakistan. MycoKeys 66: 23–38. https://doi.org/10.3897/mycokeys.66.38659

Krisai-Greilhuber I, Chen Y, Jabeen S, Madrid H, Marincowitz S, Razaq A, Ševčíková H, Voglmayr H, Yazici K, Aptroot A, Aslan A, Boekhout T, Borovička J, Crous PW, Ilyas S, Jami F, Jiang Y-L, Khalid AN, Kolecka A, Konvalinková T, Norphanphoun C, Shaheen S, Wang Y, Wingfield MJ, Wu SP, Wu YM, Yu JY (2017) Fungal systematics and evolution: FUSE 3. Sydowia 69: 229–264.

Liu LN, Razaq A, Atri NS, Bau T, Belbahri L, Bouket AC, Chen LP, Deng C, Ilyas S, Khalid AN, Kitaura MJ, Kobayashi T, Li Y, Lorenz AP, Ma YH, Malysheva E, Malysheva V, Nuytinck J, Qiao M, Saini MK, Scur MC, Sharma S, Shu LL, Spirin V, Tanaka Y, Tojo M, Uzuhashi S, Valério-Júnior C, Verbeken A, Verma B, Wu RH, Xu JP, Yu ZF, Zeng H, Zhang B, Banerjee

A, Beddiar A, Bordallo JJ, Dafri A, Dima B, Krisai-Greilhuber I, Lorenzini M, Mandal R, Morte A, Nath PS, Papp V, Pavlík J, Rodríguez A, Ševcˇíková H, Urban A, Voglmayr H, Zapparoli G (2018) Fungal Systematics and Evolution: FUSE 4. Sydowia 70: 211–286.

Martin WH, Boyce SG, Echternacht AC (1993) Biodiversity of the southeastern United States: Lowland terrestrial communities. John Wiley and Sons, New York.

Moncalvo JM, Buchanan PK (2008) Molecular evidence for long distance dispersal across the Southern Hemisphere in the *Ganoderma applanatum-australe* species complex (Basidiomycota). Mycological Research 112(4): 425–436. https://doi.org/10.1016/j.mycres.2007.12.001

Moncalvo JM, Vilgalys R, Redhead SA, Johnson JE, James TY, Aime MC, Hofstetter V, Verduin SJW, Larsson E, Baroni TJ, Thorn RG, Jacobsson S, Clémençon H, Miller OK (2002) One hundred and seventeen clades of euagarics. Molecular Phylogenetics and Evolution 23(3): 357–400. https://doi.org/10.1016/S1055-7903(02)00027-1

Money NP (2016) Fungal Diversity, In: Watkinson SC, Boddy L, Money NP (Eds) The Fungi (3rd edn.). Elsevier, 1–36. https://doi.org/10.1016/B978-0-12-382034-1.00001-3

Moreno G, Khalid AN, Alvarado P (2009) A new species of *Phallus* from Pakistan. Mycotaxon 108(1): 457–462. https://doi.org/10.5248/108.457

Moreno G, Khalid AN, Alvarado P, Kriesel H (2013) *Phallus hadriani* and *P. roseus* from Pakistan. Mycotaxon 125(1): 45–51. https://doi.org/10.5248/125.45

Mundkur BB (1938) Fungi of India. Supplement I. Scientific Monograph 12, The Imperial Council of Agricultural Research. Delhi. Manager of Publications.

Naseer A, Khalid AN (2018) A new record of genus *Craterellus*, edible basidiomycotous fungus from Pakistan. Saudi Journal of Medical and Pharmaceutical Sciences 4(6): 656–659.

Naseer A, Khalid AN (2020a) *Amanita pseudovaginata* from Pakistan. World Journal of Biology and Biotechnology 5(3): 19–21. https://doi.org/10.33865/wjb.005.03.035

Naseer A, Khalid AN, Niazi AR (2017a) *Phylloporus brunneiceps* from Pakistan. Mycotaxon 132(3): 685–693. https://doi.org/10.5248/132.685

Naseer A, Khalid AN, Smith ME (2017b) *Inocybe shawarensis* sp. nov. in the *Inosperma* clade from Pakistan. Mycotaxon 132(4): 909–918. https://doi.org/10.5248/132.909

Naseer A, Sarwar S, Khalid AN, Healy R, Smith ME (2019a) *Hortiboletus kohistanensis* (Boletaceae), a new bolete species from temperate and subalpine oak forests of Pakistan. Phytotaxa 388(3): 239–246. https://doi.org/10.11646/phytotaxa.388.3.3

Naseer A, Khalid AN, Healy R, Smith ME (2019b) Two new species of *Hygrophorus* from temperate Himalayan Oak forests of Pakistan. MycoKeys 56: 33–47. https://doi.org/10.3897/mycokeys.56.30280

Naseer A, Ghani S, Niazi AR, Khalid AN (2019c) *Inocybe caroticolor* from oak forests of Pakistan. Mycotaxon 134(2): 241–251. https://doi.org/10.5248/134.241

Naseer A, Garrido-Benavent I, Khan J, Ballara J Mahiques Rafael, Khalid, AN, Sher H (2020b) *Cortinarius pakistanicu*s and *C. pseudotorvus*: two new species in oak forests in the Pakistan Himalayas. MycoKeys 74: 91–108. http://dx.doi.org/10.3897/mycokeys.74.49734

Nasim G, Ali M, Shabbir A (2008) A study of genus *Ramaria* from Ayubia National Park, Pakistan. Mycopath 6(1&2): 43–46. https://www.academia.edu/7872584/A_study_of_genus_Ramaria_from_Ayubia_National_Park_Pakistan

Nawaz R, Khalid AN, Hanif M, Razaq A (2013) *Lepiota vellingana* sp. nov Basidiomycota, Agaricales, A new species from Lahore Pakistan. Mycological Progress 12(4): 727–732. https://doi.org/10.1007/s11557-012-0884-0

Nawaz F, Jabeen S, Khalid AN (2017) New and noteworthy *Melanoleuca* (Pluteaceae) from Pakistan. Phytotaxa 311(2): 175–184. https://doi.org/10.11646/phytotaxa.311.2.5

Niazi AR (2008) Biodiversity of ectomycorrhizas in conifers from Himalayan moist temperate forests of Pakistan. Ph.D. Thesis, Department of Botany, University of the Punjab, Lahore, Pakistan, 278 pp.

Niazi AR, Iqbal SH, Khalid AN (2006) Biodiversity of Mushrooms and Ectomycorrhiza. 1. *Russula brevipes* Peck. and its ectomycorrhiza, a new record from Himalayan moist temperate forests of Pakistan, Pakistan. Le Journal de Botanique 38(4): 1271–1277. http://www.pakbs.org/pjbot/PDFs/38(4)/PJB38(4)1271.pdf

Niazi AR, Khalid AN, Iqbal SH (2007) *Descolea flavoannulata* and its ectomycorrhiza from Pakistan's Himalayan moist temperate forests. Mycotaxon 101: 375–383. http://www.mycotaxon.com/vol/abstracts/101/101-375.html

Niazi AR, Iqbal SH, Khalid AN (2009) Ectomycorrhizae between *Amanita rubescens* and Himalayan spruce (*Picea smithiana)* from Pakistan. Mycotaxon 107(1): 73–80. https://doi.org/10.5248/107.73

Oliveira JJS, Vargas-Isla R, Cabral TS, Rodrigues DP, Ishikawa NK (2019) Progress on the phylogeny of the Omphalotaceae: *Gymnopus* s. str., *Marasmiellus* s. str., *Paragymnopus* gen. nov. and *Pusillomyces* gen. nov. Mycological Progress 18(5): 713–739. https://doi.org/10.1007/s11557-019-01483-5

Olson DM, Dinerstein E, Wikramanayake ED, Burgess ND, Powell GVN, Underwood EC, D'Amico JA, Itoua I, Strand HE, Morrison JC, Loucks CJ, Allnutt TF, Ricketts TH, Kura Y, Lamoreux JF, Wettengel WW, Hedao P, Kassem KR (2001) Terrestrial ecoregions of the world: A new map of life on Earth. Bioscience 51(11): 933–938. https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Puri GS, Gupta RK, Meher-Homji VM, Puri S (1989) Forest Ecology: Plant form, Diversity, Communities and Succession. Oxford and IBH Publications Co., New Delhi.

Qasim T, Amir T, Nawaz R, Niazi AR, Khalid AN (2015a) *Leucoagaricus lahorensis*, a new species of *L.* sect. *Rubrotincti.* Mycotaxon 130(2): 533–541. https://doi.org/10.5248/130.533

Qasim T, Khalid AN, Vellinga EC, Razaq A (2015b) *Lepiota albogranulosa* sp.nov. (Agaricales, Agaricaceae) from Lahore, Pakistan. Mycological Progress 14(5): e24. https://doi.org/10.1007/s11557-015-1037-z

Qasim T, Khalid AN, Vellinga EC (2016) A new species of Lepiota, *Lepiota lahorensis*, from Lahore, Pakistan. Turkish Journal of Botany 40(4): 419–426. https://doi.org/10.3906/bot-1507-31

Razaq A, Shahzad S (2004) *Pisolithus tinctorius*, a new record from Pakistan. Pakistan Journal of Botany 36(2): 449–451. http://www.pakbs.org/pjbot/PDFs/36(2)/PJB36(2)449.pdf

Razaq A, Shahzad S (2005a) *Hygrophorus marzuolus*, a new report from Pakistan. Pakistan Journal of Botany 37: 1031–1032. http://www.pakbs.org/pjbot/PDFs/37(4)/PJB37(4)1031.pdf

Razaq A, Shahzad S (2005b) *Lycoperdon moll*, a new record from Pakistan. Pakistan Journal of Botany 37: 783–784. http://www.pakbs.org/pjbot/PDFs/37(3)/PJB37(3)783.pdf

Razaq A, Shahzad S (2007) *Geastrum sessile* and *G. vulgatum* new records from Pakistan. Pakistan Journal of Botany 39(6): 2193–2194.

Razaq A, Shahzad S (2012) New records of Agaricaceae form Pakistan. Pakistan Journal of Botany 44(4): 1475–1477. http://www.pakbs.org/pjbot/PDFs/44(4)/47.pdf

Razaq A, Shahzad S (2013) Newly recorded species of Boletaceae form Pakistan. Pakistan Journal of Botany 45(4): 1473–1476.

Razaq A, Shahzad S (2016) New records of order Boletales from Pakistan. Pakistan Journal of Botany 48(3): 1313–1317.

Razaq A, Shahzad S (2017). Additions to the diversity of mushrooms in Gilgit-Baltistan. Pakistan Journal of Botany 49(SI): 305–309. http://pakbs.org/pjbot/papers/1496528755.pdf

Razaq A, Khalid AN, Vellinga EC (2012a) *Lepiota himalayensis* (Basidiomycota, Agaricales), a new species from Pakistan. Mycotaxon 121(1): 319–325. https://doi.org/10.5248/121.319

Razaq A, Khalid AN, Ilyas S (2012b) Molecular identification of *Lyophyllum connatum* and *Panaeolus sphinctrinus* (Basidiomycota, agaricales) from Himalayan moist temperate forests of Pakistan. International Journal of Agriculture and Biology 14: 1001–1004. http://www.fspublishers.org/published_papers/74659_.pdf

Razaq A, Khalid AN, Ilyas S (2012c) *Tricholomopsis flammula* Metrod Ex Holec (Basidiomycota, Agaricales), an addition to mushroom flora of Pakistan based on molecular identification. Pakistan Journal of Botany 44: 413–416. http://www.pakbs.org/pjbot/PDFs/44(SI1)/63.pdf

Razaq A, Khalid AN, Ilyas S (2013a) Molecular identification of *Lepiota acutesquamosa* and *L. cristata* (Basidiomycota, Agaricales) based on ITS-rDNA barcoding from Himalayan moist temperate forests of Pakistan. International Journal of Agriculture and Biology 15(2): 313–318. http://www.fspublishers.org/published_papers/63120_.pdf

Razaq A, Vellinga EC, Ilyas S, Khalid AN (2013b) *Lepiota brunneoincarnata* and *L. subincarnata*: Distribution and phylogeny. Mycotaxon 126(1): 133–141. https://doi.org/10.5248/126.133

Razaq A, Ilyas S, Khalid AN (2013c) Molecular and phenotypic descriptions of *Cystodermella cinnabarina* from Western Himalaya: A new genus for Pakistan. Journal of Mycology 1–5: 1–5. https://doi.org/10.1155/2013/793124

Razaq A, Ilyas S, Khalid AN (2013d) Molecular identification of *Marasmius oreades*-An edible mushroom from Pakistan based on ITS-rDNA sequence data. Pakistan Journal of Agricultural Sciences 50(3): 415–419. https://pakjas.com.pk/papers/2172.pdf

Razaq A, Shehzad S, Ali H, Shah AN (2014) New reported species from macrofungi from Pakistan. Journal of Agri-food and Applied Sciences 2(3): 67–71.

Razaq A, Khalid AN, Niazi AR, Ilyas S (2014a) *Russula foetenoides* sp. nov (Basidiomycota, Agaricales) a new species from Pakistan. Sydowia 66(2): 289–298.

Razaq A, Ilyas S, Khalid AN (2014b) Taxonomic and phylogenetic affinities of *Hygrophorus chrysodon* from western Himalayan forests. Austrian Journal of Mycology (Österr. Z. Pilzk.) 23: 21–29. https://www.zobodat.at/pdf/OestZPilz_23_0021-0029.pdf

Razaq A, Ilyas S, Khalid AN (2014c) Molecular identification of *Coprinus comatus*: An edible mushroom (Basidiomycota, Agaricales) commonly found in Khanspur Forest, Himalayan region of Pakistan. Research Journal of Agricultural Science 5(3): 390–394. http://rjas.org/ViewIssue?IssueId=1

Razaq A, Ilyas S, Khalid AN (2016a) Molecular identification of Chinese *Chroogomphus roseolus* from Pakistani forests, a mycorrhizal fungus, using ITS-rDNA marker. Pakistan Journal of Agricultural Sciences 53(2): 393–398. https://doi.org/10.21162/PAKJAS/16.2240

Razaq A, Nawaz R, Khalid AN (2016b) An Asian edible mushroom, *Macrocybe gigantea*: Its distribution and ITS-rDNA based phylogeny. Mycosphere. Journal of Fungal Biology 7(4): 525–530. https://doi.org/10.5943/mycosphere/7/4/11

Razaq A, Ilyas S, Khalid AN (2017) Phylogeny and taxonomy of *Hebeloma theobrominum* and *H. mesophaeum* from western Himalaya. International Journal of Agriculture and Biology 19(03): 584–588. https://doi.org/10.17957/IJAB/15.0357

Razaq A, Ilyas S, Khalid AN (2018) Molecular identification of noteworthy lignicolous fungus, *Neolentinus lepedius* (fr.) Redhead and ginns: A new genus for Pakistan using phenotypical and phylogenetic approaches. Pakistan Journal of Botany 50(6): 2385–2388. https://www.pakbs.org/pjbot/papers/1531144451.pdf

Razaq A, Rajput R, Shehzad S (2019) New records of *Russula* species from Pakistan. Pakistan Journal of Botany 51(1): 1–4. https://doi.org/10.30848/PJB2019-1(34)

Redhead S (1997) Macrofungi of British Columbia; requirements for inventory. Ministry of Forests Research Program. Work: Pap 28/1997, Victoria, B.C.

Saba M, Khalid AN (2014a) First report of *Callistosporium luteoolivaceum* from Western Himalaya, Pakistan. Mycotaxon 129(1): 73–77. https://doi.org/10.5248/129.73

Saba M, Khalid AN (2014b) New record of *Melanoleuca cinereifolia* in Himalayan moist temperate forests of Pakistan. Mycotaxon 129(2): 317–327. https://doi.org/10.5248/129.317

Saba M, Khalid AN (2014c) New reports of *Gymnopus* from Pakistan based on ITS sequences. Mycotaxon 129(1): 63–72. https://doi.org/10.5248/129.63

Saba M, Khalid AN (2015) *Russula sichuanensis* and its ectomycorrhizae from Himalayan moist temperate forests of Pakistan. Mycotaxon 130(3): 629–639. https://doi.org/10.5248/130.629

Saba M, Khalid AN (2020) *Mallocybe velutina* (Agaricales, Inocybaceae), a new species from Pakistan. Mycoscience 61(6): 348–352. https://doi.org/10.1016/j.myc.2020.06.006

Saba M, Ahmad I, Khalid AN (2015) New reports of *Inocybe* from pine forests in Pakistan. Mycotaxon 130(3): 671–681. https://doi.org/10.5248/130.671

Saba M, Khalid AN, Jabeen S, Dima B (2017) *Cortinarius longistipitatus*, a new species in subgenus *Telamonia*, section *Cinnabarini*, from Pakistan. Phytotaxa 328(3): 257–266. https://doi.org/10.11646/phytotaxa.328.3.4

Saba M, Khalid AN, Sharif S, Iqbal MS (2018) The *Heterobasidion insulare* complex from Pakistan. Mycotaxon 133(2): 261–270. https://doi.org/10.5248/133.261

Saba M, Haelewaters D, Iturriaga T, Ashraf T, Khalid AN, Pfister DH (2019a) *Geopora ahmadii* sp. nov. from Pakistan. Mycotaxon 134(2): 377–389. https://doi.org/10.5248/134.377

Saba M, Haelewaters D, Fiaz M, Khalid AN, Pfister DH (2019b) *Amanita mansehraensis*, a new species in section Vaginatae from Pakistan. Phytotaxa 409(4): 189–201. https://doi.org/10.11646/phytotaxa.409.4.1

Saba M, Khan J, Sarwar S, Sher H, Khalid AN (2020a) *Gymnopus barbipes* and *G. dysodes*, new records for Pakistan. Mycotaxon 135(1): 203–212. https://doi.org/10.5248/135.203

Saba M, Haelewaters D, Pfister DH, Khalid AN (2020b) New species of *Pseudosperma* (*Agaricales*, *Inocybaceae*) from Pakistan revealed by morphology and multi locus phylogenetic reconstruction. MycoKeys 69: 1–31. https://doi.org/10.3897/mycokeys.69.33563

Siddiqui WN, Bashir H, Khalid AN (2020) Cultivation of wild indigenous *Agaricus bisporus* and *Agaricus subrufescens* from Pakistan. Current research in Environmental & Applied Mycology (Journal of Fungal Biology): 10(1): 466–474. https:doi.org/10.5943/cream/10/1/36

Sarwar S, Khalid AN (2014) Additions to boletes: *Boletus pakistanicus* sp. nov. from coniferous forests of Pakistan. International Journal of Agriculture and Biology 16: 663–667.

Sarwar S, Khalid AN (2014b) Diversity and phylogeny of *Suillus* (Suilaceae, Boletales, Basidiomycota) from coniferous forests of Pakistan. International Journal of Agriculture and Biology 16: 489–497. http://www.fspublishers.org/published_papers/48687_.pdf

Sarwar S, Hanif M, Khalid AN, Guinberteau J (2011) Diversity of boletes in Pakistan; focus on *Suillus brevipes* and *Suillus sibiricus*. Proceedings of the 7th International Conference on Mushroom Biology and Mushroom Products 4–7 October 2011. Arcachon, France 1: 123–133.

Sarwar S, Khalid AN, Hanif M, Niazi AR (2012) *Suillus flavidus* and its ectomycorrhizae with *Pinus wallichiana* in Pakistan. Mycotaxon 12: 225–232. https://doi.org/10.5248/121.225

Sarwar S, Khalid AN, Niazi AR (2014a) *Tylopilus*: A new species and a new record from Pakistan. Mycotaxon 128(1): 1–10. https://doi.org/10.5248/128.1

Sarwar S, Saba M, Khalid AN, Dentinger BM (2015) *Suillus marginielevatus*, a new species and *S. triacicularis*, a new record from Western Himalaya, Pakistan. Phytotaxa 203(2): 169–177. https://doi.org/10.11646/phytotaxa.203.2.6

Sarwar S, Jabeen S, Khalid AN, Dentinger BTM (2016) Molecular phylogenetic analysis of fleshy pored mushrooms: *Neoboletus luridiformis* and *Hortiboletus rubellus* from Western Himalayan range of Pakistan. Pakistan Journal of Botany 48(5): 2077–2083. https://www.pakbs.org/pjbot/PDFs/48(5)/39.pdf

Sarwar S, Jabeen S, Ahmad I, Dentinger B, Khalid AN (2018a) *Boletus himalayensis* (Basidiomycota; Boletales), a new porcini species from Pakistan. Turkish Journal of Botany 42(6): 790–800. https://doi.org/10.3906/bot-1711-19

Sarwar S, Saba M, Khalid AN, Dentinger BM (2018b) *Suillus himalayensis* (Boletales: Basidiomycota: fungi) and its symbiotic association with roots of *Pinus wallichiana*, first report from coniferous forests of Pakistan. Journal of Animal and Plant Sciences 28(2): 576–583. http://www.thejaps.org.pk/docs/v-28-02/28.pdf

Sarwar S, Aziz T, Hanid M, Ilyas S, Shaheen S (2019) *Russula swatica*: A new species of russula based on molecular, light microscopy, and scanning emission microscopy analyses from swat valley of Khyber Pakhtunkhwa province of Pakistan. Microscopy Research and Technique 82(10): 1700–1705. https://doi.org/10.1002/jemt.23335

Sattar A, Kiran M, Khalid AN (2018) *Rhodocollybia utrorensis* (Agaricales, Basidiomycota): A new species and a first record of the genus *Rhodocollybia* from Pakistan. Phytotaxa 369(4): 269–277. https://doi.org/10.11646/phytotaxa.369.4.4

Schmidthüsen J (1976) Atlas zur biogeographie. Bibliographisches Institut, Mannheim, 88 pp.

Schoch CL, Seifert KA, Huhndorf S, Robert V, Spouge JL, Levesque AC, Chen W, Bolchacova E, Voigt K, Crous PW, Miller AN, Wingfield MJ, Aime MC, An K-D, Bai F-Y, Barreto RW, Begerow D, Bergeron M-J, Blackwell M, Boekhout T, Bogale M, Boonyuen

N, Burgaz AR, Buyck B, Cai L, Cai Q, Cardinali G, Chaverri P, Coppins BJ, Crespo A, Cubas P, Cummings C, Damm U, de Beer ZW, de Hoog GS, Del-Prado R, Dentinger B, Diéguez-Uribeondo J, Divakar PK, Douglas B, Dueñas M, Duong TA, Eberhardt U, Edwards JE, Elshahed MS, Fliegerova K, Furtado M, García MA, Ge Z-W, Griffith GW, Griffiths K, Groenewald JZ, Groenewald M, Grube M, Gryzenhout M, Guo L-D, Hagen F, Hambleton S, Hamelin RC, Hansen K, Harrold P, Heller G, Herrera C, Hirayama K, Hirooka Y, Ho H-M, Hoffmann K, Hofstetter V, Högnabba F, Hollingsworth PM, Hong S-B, Hosaka K, Houbraken J, Hughes K, Huhtinen S, Hyde KD, James T, Johnson EM, Johnson JE, Johnston PR, Jones EBG, Kelly LJ, Kirk PM, Knapp DG, Kõljalg U, Kovács GM, Kurtzman CP, Landvik S, Leavitt SD, Liggenstoffer AS, Liimatainen K, Lombard L, Luangsa-ard JJ, Lumbsch HT, Maganti H, Maharachchikumbura SSN, Martin MP, May TW, McTaggart AR, Methven AS, Meyer W, Moncalvo J-M, Mongkolsamrit S, Nagy LG, Nilsson RH, Niskanen T, Nyilasi I, Okada G, Okane I, Olariaga I, Otte J, Papp T, Park D, Petkovits T, Pino-Bodas R, Quaedvlieg W, Raja HA, Redecker D, Rintoul TL, Ruibal C, Sarmiento-Ramírez JM, Schmitt I, Schüßler A, Shearer C, Sotome K, Stefani FOP, Stenroos S, Stielow B, Stockinger H, Suetrong S, Suh S-O, Sung G-H, Suzuki M, Tanaka K, Tedersoo L, Telleria MT, Tretter E, Untereiner WA, Urbina H, Vágvölgyi C, Vialle A, Vu TD, Walther G, Wang Q-M, Wang Y, Weir BS, Weiß M, White MM, Xu J, Yahr R, Yang ZL, Yurkov A, Zamora J-C, Zhang N, Zhuang W-Y, Schindel D, Fungal Barcoding Consortium (2012) Nuclear ribosomal internal transcribed spacer (ITS) region as a universal DNA barcode marker for Fungi. Proceedings of the National Academy of Sciences of the United States of America 109(16): 6241–6246. https://doi.org/10.1073/pnas.1117018109

Schultz J (1995) The Ecozones of the World: The Ecological Divisions of the Geosphere. Springer-Verlag, Berlin, 252 pp.

Sher H, Khan J, Khalid AN (2018) *Clavariadelphus elongatus* sp. nov. (Basidiomycota; Clavariadelphaceae)-Addition to the Club Fungi of Pakistan. Phytotaxa 365(2): 182–188. https://doi.org/10.11646/phytotaxa.365.2.5

Song J, Liang JF, Mehrabi-Koushki M, Krisai-Greilhuber I, Ali B, Bhatt VK, Cerna-Mendoza A, Chen B, Chen ZX, Chu HL, Corazon-Guivin MA, Alves da Silva G, Kesel AD, Dima B, Dovana F, Farokhinejad R, Ferisin G, Guerrero-Abad JC, Guo T, Han LH, Ilyas S, Justo A, Khalid AN, Khodadadi-Pourarpanahi S, Li TH, Liu C, Lorenzini M, Lu JK, Mumtaz AS, Oehl F, Pan XU, Papp V, Qian W, Razaq A, Semwal KC, Tang LZ, Tian XL, Vallejos-Tapullima A, van der Merwe NA, Wang SK, Wang CQ, Yang RH, Yu F, Zapparoli G, Zhang M, Antonin V, Aptroot A, Aslan A, Banerjee A, Chatterjee S, Dirks AC, Ebrahimi L, Fotouhifar KB, Ghosta Y, Kalinina LB, Karahan D, Liu J, Maiti MK, Mookherjee A, Nath PS, Panja B, Saha J, Ševčíková H, Voglmayr H, Yazici K, Haelewaters D (2019) Fungal Systematics and Evolution: FUSE 5. Sydowia 71: 141–245.

Stein B (2002) States of the Union: Ranking America's Biodiversity. Retrieved from Arlington, Virginia. www.natureserve.org/library/stateofunions.pdf

Sultana K, Rizwana AQ (2007) Distribution of medicinally important mushrooms of mountainous/northern areas of Pakistan. Plant Pathology Journal 6(2): 183–186. https://doi.org/10.3923/ppj.2007.183.186

Sultana K, Rauf CA, Riaz A, Naz F, Irshad G, Haque MIU (2011) Checklist of agarics of Kaghan Valley-1. Pakistan Journal of Botany 43(3): 1777–1787. http://www.pakbs.org/pjbot/PDFs/43(3)/PJB43(3)1777.pdf

Sultana K, Riaz N, Irshad G, Khan AN (2014) Contribution to mushroom flora of Rawalpindi-Islamabad. Journal of Bioresource Management 1(1): 27–31. https://doi.org/10.35691/JBM.4102.0002

Thongklang N, Nawaz R, Khalid AN, Chen J, Hyde KD, Zhao RL, Parra LA, Hanif M, Moinard M, Callac P (2014) Morphological and molecular characterization of three *Agaricus* species from tropical Asia (Pakistan, Thailand) reveals a new group in section *Xanthodermatei*. Mycologia 106(6): 1220–1232. https://doi.org/10.3852/14-076

Tulloss RE, Iqbal SH, Khalid AN, Bhatt RP, Bhatt VK (2001) Studies in *Amanita* (Amanitaceae) from southern Asia. I. Some species of Pakistan's Northwestern Frontier Province. Mycotaxon-Ithaca Ny 77: 455–490.

Tulloss RE, Iqbal SH, Khalid AN (2005) Studies in *Amanita* (Amanitaceae) from southern Asia II. *Amanita cinnamomescens*-new species of Pakistan's North West Frontier Province. Mycotaxon 94: 1001–1005.

Ullah S, Vizzini A, Fiaz M, Ur Rehman H, Sher H, Khalid AN (2019a) *Strobilomyces longistipitatus* (Boletaceae) newly recorded from Hindukush and Himalayan moist temperate forests of Pakistan. Nova Hedwigia 108(1–2): 243–254. https://doi.org/10.1127/nova_hedwigia/2018/0495

Ullah S, Wilson AW, Tulloss RE, Fiaz M, Mueller GM, Khalid AN (2019b) *Amanita cinis* and *A. olivovaginata* (Basidiomycota, Amanitaceae), two new species, and the first record of *A. emodotrygon*, from Northwestern Pakistan. Turkish Journal of Botany 43(6): 831–849. https://doi.org/10.3906/bot-1903-21

Ullah S, Wilson AW, Fiaz M, Hussain Mueller SG, Khalid AN (2020b) *Russula shanglaensis* sp. nov. (Basidiomycota: Russulales), a new species from the mixed coniferous forests in District Shangla, Pakistan. Turkish Journal of Botany 44(1): 85–92. https://doi.org/10.3906/bot-1907-3

Ullah Z, Jabeen S, Ahmad H, Khalid AN (2018) *Inocybe pakistanensis*, a new species in section Rimosae s. str. from Pakistan. Phytotaxa 348(4): 279–288. https://doi.org/10.11646/phytotaxa.348.4.4

Ullah Z, Jabeen S, Faisal M, Ahmad H, Khalid AN (2019) *Leucoagaricus brunneus* sp. nov. from Khyber Pakhtunkhwa, Pakistan. Mycotaxon 134(4): 601–611. https://doi.org/10.5248/134.601

Ullah Z, Khurshid R, Khan MB, Ahmad I, Jabeen S, Faisal M, Ahmad H, Fiaz M, Khalid AN (2020a) *Melanoleuca kashmirensis* sp. nov. in subg. *Urticocystis* from Pakistan. Phytotaxa 434(1): 89–100. https://doi.org/10.11646/phytotaxa.434.1.6

UNESCO United Nations Educational, Scientific and Cultural Organization (1969) A Framework for a Classification of World Vegetation. UNESCO SC/WS/269, UNESCO, Paris.

Usman M, Khalid AN (2018) *Leucoagaricus pabbiensis* sp. nov. from Punjab, Pakistan. Mycotaxon 133(2): 355–364. https://doi.org/10.5248/133.355

Usman M, Khalid AN (2020a) *Zhuliangomyces pakistanicus*, a new species of *Zhuliangomyces* (Amanitaceae: Basidiomycota) from Pakistan. Phytotaxa 443(2): 198–206. https://doi.org/10.11646/phytotaxa.443.2.7

Usman M, Khalid AN (2020b) *Termitomyces acriumbonatus* sp. nov. (Lyophyllaceae, Agaricales) from Pakistan. Phytotaxa 477(2): 217–228. https://doi.org/10.11646/phytotaxa.477.2.6

Vasco-Palacios AM, Franco-Molano AE (2013) Diversity of Colombian macrofungi (Ascomycota- Basidiomycota) Mycotaxon 121: 1–58. http://www.mycotaxon.com/resources/checklists/VascoPalacios-v121-checklist.pdf

Volk TJ (2013) Fungi. In: Levin SA (Ed.) Encyclopedia of Biodiversity (Second edition). Academic Press, 624–640. https://doi.org/10.1016/B978-0-12-384719-5.00062-9

Walter H, Box E (1976) Global classification of natural terrestrial ecosystems. Vegetation 32(2): 75–81. https://doi.org/10.1007/BF02111901

Wang Z, Nilsson RH, James TY, Dai Y, Townsend JP (2016) Future perspectives and challenges of fungal systematics in the age of big data. In: Li D-W (Ed.) Biology of Microfungi. Springer International Publishing, Cham, 25–46. https://doi.org/10.1007/978-3-319-29137-6_3

Weins JA, Crawford CS, Gosz JR (1985) Boundary dynamics: A conceptual framework for studying landscape ecosystems. Oikos 45(3): 421–427. https://doi.org/10.2307/3565577

White TJ, Bruns TD, Lee SB, Taylor JW (1990) Amplification and direct sequencing of fungal ribosomal RNA genes for phylo- genetics. In: Innis MA, Gelfand DH, Sninsky JJ, White TJ (Eds) PCR Protocols – A Guide to Methods and Applications. Academic Press, New York, 315–322. https://doi.org/10.1016/B978-0-12-372180-8.50042-1

Wikramanayake E, Dinerstein E, Loucks CJ, Olson DM, Morrison J, Lamoreux J, McKnight M, Hedao P (2002) Terrestrial Ecoregions of the Indo-Pacific: A Conservation Assessment. Island Press, Washington D.C., 345 pp.

Wu B, Hussain M, Zhang W, Stadler M, Liu X, Xiang M (2019) Current insights into fungal species diversity and perspective on naming the environmental DNA sequences of fungi. Mycology 10(3): 127–140. https://doi.org/10.1080/21501203.2019.1614106

Wulff AS, Hollingsworth PM, Ahrends A, Jaffré T, Veillon J-M, L'Huillier L, Fogliani B (2013) Conservation priorities in a biodiversity hotspot: Analysis of narrow endemic plant species in New Caledonia. PLoS ONE 8(9): e73371. https://doi.org/10.1371/journal.pone.0073371

Yousaf N, Kreisel H, Khalid AN (2012a) *Bovista himalaica* sp. nov. (gasteroid fungi; Basidiomycetes) from Pakistan. Mycological Progress 12(3): 569–574. https://doi.org/10.1007/s11557-012-0864-4

Yousaf N, Niazi AR, Khalid AN (2012b) New records of noteworthy Gasteroid fungi from Pakistan. Mycotaxon 119(1): 261–267. https://doi.org/10.5248/119.261

Yousaf N, Khalid AN, Niazi AR (2012c) New records of *Scleroderma* species (*Sclerodermataceae*, *Agaricomycetes*) from Pakistan. Mycotaxon 122(1): 43–50. https://doi.org/10.5248/122.43

Yousaf N, Khalid AN, Niazi AR (2013a) Taxonomy of gasteroid fungi from some arid regions of Punjab, Pakistan. Journal of Biodiversity and Environmental Sciences 3(9): 253–263.

Yousaf N, Niazi AR, Khalid AN (2013b) *Myriostoma coliforme*, first record of a rare and endangered gasteroid basidiomycetes from Pakistan. International Journal of Microbiology and Mycology 1(2): 1–6. https://doi.org/10.6084/M9.FIGSHARE.1375509.V1

Yousaf N, Fiaz M, Ahmad H, Khalid AN (2014) Gasteroid Mycota of District Mansehra, Khyber Pakhtunkhwa, Pakistan. International Journal of Agriculture and Biology 16: 571–577. http://www.fspublishers.org/published_papers/19120_.pdf

Yuan HS, Lu X, Dai YC, Hyde KD, Kan YE, Kušan I, He SH, Liu NG, Sarma VV, Zhao CL, Cui BK, Yousaf N, Sun G, Liu SY, Wu F, Lin CG, Dayarathne MC, Gibertoni TB, Conceição LB, Garibay-Orijel R, Villegas-Ríos M, Salas-Lizana R, Wei TZ, Qiu JZ, Yu ZF, Phookamsak R, Zeng M, Paloi S, Bao DF, Abeywickrama PD, Wei DP, Yang J, Manawasinghe IS, Harishchandra D, Brahmanage RS, de Silva NI, Tennakoon DS, Karunarathna A, Gafforov Y, Pem D, Zhang SN, de Azevedo Santiago ALCM, Bezerra JDP, Dima B, Acharya K, Alvarez-Manjarrez J, Bahkali AH, Bhatt VK, Brandrud TE, Bulgakov TS, Camporesi E, Cao T, Chen YX, Chen YY, Devadatha B, Elgorban AM, Fan LF, Du X, Gao L, Gonçalves CM, Gusmão LFP, Huanraluek N, Jadan M, Jayawardena RS, Khalid AN, Langer E, Lima DX, de Lima-Júnior NC, de Lira CRS, Liu JK, Liu S, Lumyong S, Luo ZL, Matočec N, Niranjan M, Oliveira-Filho JBC, Papp V, Pérez-Pazos E, Phillips AJL, Qiu PL, Ren Y, Ruiz RFC, Semwal KC, Soop K, de Souza CAF, Souza-Motta CM, Sun LH, Xie ML, Yao YJ, Zhao Q, Zhou LW (2020) Fungal diversity notes 1277–1386: Taxonomic and phylogenetic contributions to fungal taxa. Fungal Diversity 104(1): 1–266. https://doi.org/10.1007/s13225-020-00461-7

Zhao J, Guangmei Z, Huadong W, Jialine X (1990) The Natural History of China. McGraw-Hill Publishing Company, New York, USA, 224 pp.

Zhao CL, Saba M, Khalid AN, Song J, Pfister DH (2017) *Heterobasidion amyloideopsis* sp. nov. (Basidiomycota, Russulales) evidenced by morphological characteristics and phylogenetic analysis. Phytotaxa 317(3): 199–210. https://doi.org/10.11646/phytotaxa.317.3.4

Supplementary material 1

Macrofungi list by biome and ecoregion of Pakistan

Authors: Nourin Aman

Data type: Base data for biomes and ecoregions of Pakistan

Explanation note: WWF description data for biomes and ecoregion of Pakistan is compiled in one document for readers ease of understanding of ecoregions present in Pakistan. The source of data is WWF official site, wikipedia and Dopa explorer. However, author added macrofungal genera recorded from each ecoregion.

Link: https://doi.org/10.3897/mycokeys.89.81148.suppl1

Supplementary material 2

Detailed taxonomic checklist of macrofungi of Pakistan

Authors: Nourin Aman, Abdul Nasir Khalid & Jean-Marc Moncalvo

Data type: Checklist with detailed references, localities, biome and ecoregion

Explanation note: The detailed references and localities of each taxon is given and allocated biome and ecoregion according to localities mentioned in references consulted.

Link: https://doi.org/10.3897/mycokeys.89.81148.suppl2