

Table S1. Identification of isolated fungi and percentage at phylum, family, and genus level.

Phylum	Isolate s%	Family	Isolates %	Genus	No. Isolate s	Isolates %
<i>Ascomycota</i>	84.4	<i>Saccharomycetaceae</i>	32.5	<i>Debaryomyces</i>	40	26.0
				<i>Candida</i>	10	6.5
		<i>Trichocomaceae</i>	22.1	<i>Penicillium</i>	33	21.4
				<i>Aspergillus</i>	1	0.6
		<i>Pseudeurotiaceae</i>	15.6	<i>Pseudogymnoascus</i>	20	13.0
				<i>Leuconeurospora</i>	4	2.6
		<i>Cladosporiaceae</i>	2.6	<i>Cladosporium</i>	4	2.6
		<i>Dothioraceae</i>	1.9	<i>Aureobasidium</i>	3	1.9
		<i>Clavicipitaceae</i>	1.3	<i>Metapochonia</i>	1	0.6
				<i>Pochonia</i>	1	0.6
		<i>Nectriaceae</i>	1.3	<i>Dialonectria</i>	1	0.6
				<i>Fusarium</i>	1	0.6
		<i>Chaetomiaceae</i>	0.6	<i>Chaetomium</i>	1	0.6
		<i>Didymellaceae</i>	0.6	<i>Epicoccum</i>	1	0.6
		<i>Hypocreaceae</i>	0.6	<i>Trichoderma</i>	1	0.6
		<i>Incertae sedis</i>	0.6	<i>Sarocladium</i>	1	0.6
		<i>Microascaceae</i>	0.6	<i>Doratomyces</i>	1	0.6
		<i>Myxotrichaceae</i>	0.6	<i>Oidiodendron</i>	1	0.6
		<i>Plectosphaerellaceae</i>	0.6	<i>Verticillium</i>	1	0.6
		<i>Pleosporaceae</i>	0.6	<i>Alternaria</i>	1	0.6
		<i>Sordariomycetes</i>	0.6	<i>Coniochaeta</i>	1	0.6
		<i>Torulaceae</i>	0.6	<i>Torula</i>	1	0.6
<i>Basidiomycota</i>	13.8	<i>Trichosporonaceae</i>	7.1	<i>Apiotrichum</i>	8	5.2
				<i>Pascua</i>	2	1.3
				<i>Cutaneotrichosporon</i>	1	0.6
		<i>Mrakiaceae</i>	6.5	<i>Tausonia</i>	9	5.8
				<i>Apiotrichum</i>	1	0.6
<i>Mucoromycota</i>	1.9	<i>Tremellaceae</i>	0.6	<i>Papiliotrema</i>	1	0.6
		<i>Mucoraceae</i>	1.9	<i>Mucor</i>	3	1.9

Table S2. Primer information and PCR protocols used in this study

Molecular marker ^a	Primer name	Primer sequence (5'-3')	PCR protocol
ITS	ITS1 [1]	TCCGTAGGTGAACCTGCG	1. 94 °C, 5 min 2. 94 °C, 1 min 3. 52 °C, 1 min 4. 72 °C, 1 min 5. Repeat 2-4 for 37 cycles 6. 72 °C, 10 min [2]
	ITS4 [1]	TCCTCCGCTTATTGATATG C	
LSU	LR0R [3]	ACCCGCTGAACTTAAGC	1. 95 °C, 3 min 2. 95 °C, 30 sec 3. 54 °C, 30 sec 4. 72 °C, 1 min 20 sec 5. Repeat 2-4 for 38 cycles 6. 72 °C, 5 min [5]
	LR7 [4]	TACTACCACCAAGATCT	
Tef1- α	EF1-983 F [6]	GCYCCYGGHCAYCGTGAY TTYAT	1. 94 °C, 2 min 2. 66 °C-56 °C touchdown (9 cycles) 3. 94 °C, 30 sec 4. 56 °C, 1 min 5. 72 °C, 1 min 6. Repeat 3-5 for 36 cycles 6. 72 °C, 10 min [6]
	EF1-2218 R [6]	ATGACACCACRACRGCACR GTYTG	
MCM7	MCM7-709 for [7]	ACIMGIGTITCVGAYGTHA ARCC	1. 94 °C, 5 min 2. 94 °C, 45 sec 3. 56 °C, 50 sec 4. 72 °C, 1 min 5. Repeat 2-4 for 38 cycles 6. 72 °C, 5 min [7,8]
	MCM7-1348 rev [7]	GAYTTDGCACICCCIGRTC WCCCAT	
RPB2	fRPB2-7 cF [9]	ATGGGYAARCAAGCYATG GG	1. 94 °C, 3 min 2. 94 °C, 20 sec 3. 55 °C, 30 sec 4. 72 °C, 1 min 5. Repeat 2-4 for 38 cycles 6. 72 °C, 10 min [9]
	RPB2-3053 bR [10]	TGRATYTTRTCRTCSACCA T	
<i>Pd</i> -specific primer	nu-SSI(1506)-184-5'-Gd [11]	GGGGACGTCCTAAAGCCT	1. 98 °C, 2 min 2. 98 °C, 10 sec 3. 50 °C, 30 sec 4. 72 °C, 1 min 5. Repeat 2-4 for 40 cycles 6. 72 °C, 7 min [11]
	nu-5.8S-144-3'-Gd [11]	TTGTAATGACGCTCGGAC	

^aITS: ribosomal internal transcribed spacer, LSU: 28S large subunit rRNA gene, Tef1- α : translation elongation factor 1 alpha, MCM7: minichromosomal maintenance protein 7, RPB2: RNA polymerase II second largest subunit, *Pd*-specific primer: *Pseudogymnoascus destructans* diagnose specific primers

Table S3. GenBank accession numbers of the sequences used in this study. Sequences highlighted in bold were generated in this study [12-15].

No	Species	Strain ^a	Locality	Substrate /host	Accession No.				
					ITS	LSU	MCM7	RPB2	TEF1
1	<i>Pseudogymnoascus destructans</i>	20631-21	New York, USA	<i>Myotis lucifugus</i>	EU884921	KF017865	KF017691	KF017747	KF017806
2	<i>Geomyces auratus</i>	CBS 108.14	Norway	Soil, filter paper bait	KF039895	KF017864	KF017690	KF017746	KF017805
3	<i>Geomyces</i> sp.	23WI05	Wisconsin, USA	Hibernacula soil	JX270595	KF017857	KF017683	KF017740	KF017798
4	<i>Pseudeurotium zonatum</i>	CBS 329.36/ AFTOL-ID 1912	France	Soil near gas leakage	AY129286	DQ470988	na ^b	DQ470940	DQ471112
5	<i>Pseudogymnoascus</i> sp.	01NH08	New Hampshire, USA	Hibernacula soil	JX270343	KF017816	KF017647	KF017701	KF017756
6	<i>Pseudogymnoascus</i> sp.	02NH05	New Hampshire, USA	Hibernacula soil	JX270350	KF017818	KF017649	KF017703	KF017758
7	<i>Pseudogymnoascus</i> sp.	02NH11	New Hampshire, USA	Hibernacula soil	JX270356	KF017819	KF017650	KF017704	KF017759
8	<i>Pseudogymnoascus</i> sp.	03VT05	Vermont, USA	Hibernacula soil	KF039892	KF017820	KF017651	KF017705	KF017760
9	<i>Pseudogymnoascus</i> sp.	04NY11	New York, USA	Hibernacula soil	JX270375	KF017821	KF017652	KF017706	KF017761
10	<i>Pseudogymnoascus</i> sp.	04NY16	New York, USA	Hibernacula soil	JX270377	KF017822	KF017653	KF017707	KF017762
11	<i>Pseudogymnoascus</i> sp.	04NY17A	New York, USA	Hibernacula soil	JX270378	KF017823	KF017654	KF017708	KF017763
12	<i>Pseudogymnoascus</i> sp.	05NY06	New York, USA	Hibernacula soil	JX270385	KF017824	KF017655	KF017709	KF017764
13	<i>Pseudogymnoascus</i> sp.	05NY08	New York, USA	Hibernacula soil	JX270387	KF017825	KF017656	KF017710	KF017765
14	<i>Pseudogymnoascus</i> sp.	05NY09	New York, USA	Hibernacula soil	JX270388	KF017826	KF017657	KF017711	KF017766
15	<i>Pseudogymnoascus</i> sp.	07MA02	Massachusetts, USA	Hibernacula soil	JX270402	KF017827	KF017658	KF017712	KF017767
16	<i>Pseudogymnoascus</i> sp.	10NY08	New York, USA	Hibernacula soil	JX270432	KF017829	KF017659	KF017714	KF017769
17	<i>Pseudogymnoascus</i> sp.	10NY09	New York, USA	Hibernacula soil	JX270433	KF017830	KF017660	KF017715	KF017770
18	<i>Pseudogymnoascus</i> sp.	10NY10	New York, USA	Hibernacula soil	JX270434	KF017831	na	KF017716	KF017771
19	<i>Pseudogymnoascus</i> sp.	11MA03	Massachusetts, USA	Hibernacula soil	JX270438	KF017832	KF017661	KF017717	KF017772
20	<i>Pseudogymnoascus</i> sp.	11MA05	Massachusetts, USA	Hibernacula soil	JX270440	KF017833	KF017662	KF017718	KF017773

No	Species	Strain ^a	Locality	Substrate /host	Accession No.				
					ITS	LSU	MCM7	RPB2	TEF1
21	<i>Pseudogymnoascus</i> sp.	11MA07	Massachusetts, USA	Hibernacula soil	JX270442	KF017834	KF017663	KF017719	KF017774
22	<i>Pseudogymnoascus</i> sp.	11MA08	Massachusetts, USA	Hibernacula soil	JX270443	KF017835	KF017664	KF017720	KF017775
23	<i>Pseudogymnoascus</i> sp.	12NJ13	New Jersey, USA	Hibernacula soil	JX270459	KF017838	KF017667	KF017722	KF017778
24	<i>Pseudogymnoascus</i> sp.	14PA06	Pennsylvania, USA	Hibernacula soil	JX270469	KF017839	KF017668	KF017723	KF017779
25	<i>Pseudogymnoascus</i> sp.	15PA10B	Pennsylvania, USA	Hibernacula soil	KF039894	KF017842	KF017670	KF017726	KF017782
26	<i>Pseudogymnoascus</i> sp.	15PA11	Pennsylvania, USA	Hibernacula soil	JX270486	KF017843	KF017671	KF017727	KF017783
27	<i>Pseudogymnoascus</i> sp.	17WV03	West Virginia, USA	Hibernacula soil	JX270510	KF017844	KF017672	KF017728	KF017784
28	<i>Pseudogymnoascus</i> sp.	17WV06	West Virginia, USA	Hibernacula soil	JX270513	na	KF017673	KF017729	KF017785
29	<i>Pseudogymnoascus</i> sp.	18VA07	Virginia, USA	Hibernacula soil	JX270527	KF017847	KF017675	na	KF017788
30	<i>Pseudogymnoascus</i> sp.	18VA08	Virginia, USA	Hibernacula soil	JX270528	KF017848	KF017676	KF017731	KF017789
31	<i>Pseudogymnoascus</i> sp.	18VA12	Virginia, USA	Hibernacula soil	JX270532	KF017849	na	KF017732	KF017790
32	<i>Pseudogymnoascus</i> sp.	18VA13	Virginia, USA	Hibernacula soil	JX270533	KF017850	na	KF017733	KF017791
33	<i>Pseudogymnoascus</i> sp.	20KY08	Kentucky, USA	Hibernacula soil	JX270562	KF017851	KF017677	KF017734	KF017792
34	<i>Pseudogymnoascus</i> sp.	20KY10	Kentucky, USA	Hibernacula soil	JX270563	KF017852	KF017678	KF017735	KF017793
35	<i>Pseudogymnoascus</i> sp.	20KY12	Kentucky, USA	Hibernacula soil	JX270565	KF017853	KF017679	KF017736	KF017794
36	<i>Pseudogymnoascus</i> sp.	21IN01	Indiana, USA	Hibernacula soil	JX270568	KF017854	KF017680	KF017737	KF017795
37	<i>Pseudogymnoascus</i> sp.	21IN05	Indiana, USA	Hibernacula soil	JX270572	KF017855	KF017681	KF017738	KF017796
38	<i>Pseudogymnoascus</i> sp.	21IN10	Indiana, USA	Hibernacula soil	JX270577	KF017856	KF017682	KF017739	KF017797
39	<i>Pseudogymnoascus</i> sp.	24MN04	Minnesota, USA	Hibernacula soil	JX270612	KF017859	KF017685	KF017741	KF017800
40	<i>Pseudogymnoascus</i> sp.	24MN06	Minnesota, USA	Hibernacula soil	JX270614	KF017860	KF017686	KF017742	KF017801
41	<i>Pseudogymnoascus</i> sp.	24MN13	Minnesota, USA	Hibernacula soil	JX270621	KF017861	KF017687	KF017743	KF017802
42	<i>Pseudogymnoascus</i> sp.	24MN14	Minnesota, USA	Hibernacula soil	JX270622	KF017862	KF017688	KF017744	KF017803

No	Species	Strain ^a	Locality	Substrate /host	Accession No.				
					ITS	LSU	MCM7	RPB2	TEF1
43	<i>Pseudogymnoascus</i> sp.	24MN18	Minnesota, USA	Hibernacula soil	JX270626	KF017863	KF017689	KF017745	KF017804
44	<i>Pseudogymnoascus</i> sp.	A07MA10	Massachusetts, USA	Hibernacula soil	KF039893	KF017828	na	KF017713	KF017768
45	<i>Pseudogymnoascus shaanxiensis</i>	GZUIFR HZ5.7	China	Soil	MT509366	MT509380	MT534206	MT534220	MT534231
46	<i>Pseudogymnoascus sinensis</i>	CGMCC 3.18493 (K278)	China	Soil	MT509364	MT509378	MT534204	MT534218	MT534229
47	<i>Pseudogymnoascus guizhouensis</i>	GZUIFR 376.1	China	Soil	MT509369	MT509383	MT534209	MT534223	MT534234
48	<i>Pseudogymnoascus antarcticus</i>	CHFC-EA 569 (F09-T2-1)	Antarctica	Antarctic marine sponge	JX845280	MN417282	MN432493	MN418135	MN418131
49	<i>Pseudogymnoascus australis</i>	CHFC-EA 567 (F09-T18-3)	Antarctica	Antarctic marine sponge	MN417287	MN417284	MN432491	MN418137	MN418133
50	<i>Pseudogymnoascus griseus</i>	CHFC-EA 568 (F09-T18-14)	Antarctica	Antarctic marine sponge	MN417288	MN417285	MN432492	MN418138	MN418134
51	<i>Pseudogymnoascus lanuginosus</i>	CHFC-EA 570 (F09-T18-27)	Antarctica	Antarctic marine sponge	MN417286	MN417283	MN418139	MN418136	MN418132
52	<i>Pseudogymnoascus turneri</i>	LHU121	Pennsylvania, USA	Sediment	MN542213	na	na	MN541380	MN541379
53	<i>Pseudogymnoascus lindneri</i>	LHU158	Pennsylvania, USA	Sediment	MN542212	na	na	MN541384	MN541383
54	<i>Pseudogymnoascus palmeri</i>	LHU407	Pennsylvania, USA	Cave sediment	MT988150	na	na	MW054468	MW054467
55	<i>Pseudogymnoascus</i> sp.	VKM F-103	New York, USA	Top soil	JPKB010015 24 ^c	JPKB01001 524	JPKB01001 753	JPKB01001 744	JPKB01001 786
					(1 to 491)	(560 to 1413)	(13559 to 14177)	(6669 to 7432)	(12082-12985)
56	<i>Pseudogymnoascus</i> sp.	VKM F-3775	Germany	Soil from a wheat field	JPJT010068 01	JPJT01006 801	JPJT010068 17	JPJT010048 17	JPJT010005 24
					(2157 to 2734)	(2803 to 4000)	(1917 to 2535)	(6048 to 6811)	(8398 to 9301)
57	<i>Pseudogymnoascus</i> sp.	VKM F-4514	Kolyma Lowland, Russia	Permafrost soil	JPJX010027 11	JPJX01002 812	JPJX010009 52	JPJX010004 86	JPJX010013 37
					(178 to 755)	(1 to 973)	(6565 to 7183)	(13807 to 14571)	(38563 to 39010)
58	<i>Pseudogymnoascus</i> sp.	22984-1-I1	Tennessee, USA	<i>Perimyotis subflavus</i>	JX415262	KF017866	KF017692	na	KF017807
59	<i>Pseudogymnoascus</i> sp.	23014-1-I6	Tennessee, USA	<i>Lasionycteris noctivagans</i>	JX512256	KF017867	KF017693	KF017748	KF017808
60	<i>Pseudogymnoascus</i> sp.	23342-1-I1	Wisconsin, USA	<i>Perimyotis subflavus</i>	JX415266	KF017868	KF017694	KF017749	KF017809

No	Species	Strain ^a	Locality	Substrate /host	Accession No.				
					ITS	LSU	MCM7	RPB2	TEF1
61	<i>Pseudogymnoascus</i> sp.	RMF C 101	Utah, USA	Soil from desert grasslands	KF039896	KF017869	KF017695	KF017750	KF017810
62	<i>Pseudogymnoascus</i> sp.	RMF 7792	Wyoming, USA	Periglacial soil	KF039898	KF017871	KF017697	KF017752	KF017812
63	<i>Pseudogymnoascus palmeri</i>	WSF 3629	Wisconsin, USA	Amorphous peat	KF039897	KF017870	KF017696	KF017751	KF017811
64	<i>Pseudogymnoascus pannorum</i>	ATCC 16222	West Germany, Germany	Soil from wheat field	AF015789	na	KF686777	na	KF686766
65	<i>Pseudogymnoascus</i> sp.	MN-Mycosel-7	Minnesota, USA	Hibernacula soil	KF039899	KF017872	KF017698	KF017753	KF017813
66	<i>Pseudogymnoascus verrucosus</i>	UAMH 10579	Alberta, Canada	brown-rotted wood bait block	NR_111197	na	XM_018270150	XM_018270703	XM_018277618
67	<i>Pseudogymnoascus turneri</i>	Ps5	Pennsylvania, USA	Sediment	MN542214	na	na	MN541382	MN541381
68	<i>Pseudogymnoascus guizhouensis</i>	GZUIFR 376.2	China	Soil	MT509370	MT509384	MT534210	MT534224	MT534235
69	<i>Pseudogymnoascus yunnanensis</i>	GZUIFR 21.807	China	Soil	MZ444072	MZ444099	MZ490754	MZ488537	MZ488514
70	<i>Pseudogymnoascus yunnanensis</i>	GZUIFR 21.808	China	Soil	MZ444073	MZ444100	MZ490755	MZ488538	MZ488515
71	<i>Pseudogymnoascus zhejiangensis</i>	GZUIFR 21.810	China	Soil	MZ444075	MZ444102	MZ490757	MZ488540	MZ488517
72	<i>Pseudogymnoascus zhejiangensis</i>	GZUIFR 21.811	China	Soil	MZ444076	MZ444103	MZ490758	MZ488541	MZ488518
73	<i>Pseudogymnoascus catenatus</i>	GZUIFR 21.813	China	Soil	MZ444078	MZ444105	MZ490760	MZ488543	MZ488520
74	<i>Pseudogymnoascus catenatus</i>	GZUIFR 21.814	China	Soil	MZ444079	MZ444106	MZ490761	MZ488544	MZ488521
75	<i>Pseudogymnoascus fujianensis</i>	GZUIFR 21.819	China	Soil	MZ444084	MZ444111	MZ490766	MZ488549	MZ488526
76	<i>Pseudogymnoascus fujianensis</i>	GZUIFR 21.820	China	Soil	MZ444085	MZ444112	MZ490767	MZ488550	MZ488527
77	<i>Pseudogymnoascus</i> sp.	19BE01LM3	South Korea	Bat habitat soil	ON545818	ON553446	ON614743	ON614763	ON707013
78	<i>Pseudogymnoascus</i> sp.	19BE02LM3	South Korea	Bat habitat soil	ON545819	ON553447	ON614744	ON614764	ON707014
79	<i>Pseudogymnoascus</i> sp.	19BE05LM1	South Korea	Bat habitat soil	ON545820	ON553448	ON614745	ON614765	ON707015
80	<i>Pseudogymnoascus</i> sp.	20BE01LM1	South Korea	Bat habitat soil	ON545821	ON553449	ON614746	ON614766	ON707016

No	Species	Strain ^a	Locality	Substrate /host	Accession No.				
					ITS	LSU	MCM7	RPB2	TEF1
81	<i>Pseudogymnoascus</i> sp.	20BE05LM1	South Korea	Bat habitat soil	ON545822	ON553450	ON614747	ON614767	ON707026
82	<i>Pseudogymnoascus</i> sp.	20BE06LM1	South Korea	Bat habitat soil	ON545823	ON553451	ON614748	ON614768	ON707017
83	<i>Pseudogymnoascus</i> sp.	20BE09LM2	South Korea	Bat habitat soil	ON545824	ON553452	ON614749	ON614769	ON707020
84	<i>Pseudogymnoascus</i> sp.	20BE10LM1	South Korea	Bat habitat soil	ON545825	ON553453	ON614750	ON614770	ON707021
85	<i>Pseudogymnoascus</i> sp.	20BE20LM3	South Korea	Bat habitat soil	ON545826	ON553454	ON614751	ON614771	ON707022
86	<i>Pseudogymnoascus</i> sp.	20BE25LM2	South Korea	Bat habitat soil	ON545827	ON553455	ON614752	ON614772	ON707023
87	<i>Pseudogymnoascus</i> sp.	20BE27LM1	South Korea	Bat habitat soil	ON545828	ON553456	ON614753	ON614773	ON707018
88	<i>Pseudogymnoascus</i> sp.	20BE35LM1	South Korea	Bat habitat soil	ON545829	ON553457	ON614754	ON614774	ON707019
89	<i>Pseudogymnoascus</i> sp.	20BE36LM4	South Korea	Bat habitat soil	ON545830	ON553458	ON614755	ON614775	ON707024
90	<i>Pseudogymnoascus</i> sp.	20BE38LM1	South Korea	Bat habitat soil	ON545831	ON553459	ON614756	ON614776	ON707025
91	<i>Pseudogymnoascus</i> sp.	19BG05LM3	South Korea	Bat guano	ON545832	ON545849	ON614757	ON614777	ON707007
92	<i>Pseudogymnoascus</i> sp.	19BG18LM2	South Korea	Bat guano	ON545833	ON545850	ON614758	ON614778	ON707008
93	<i>Pseudogymnoascus</i> sp.	20BOS05LM2	South Korea	Bat oral swab	ON545834	ON553460	ON614742	ON614779	ON707009
94	<i>Pseudogymnoascus</i> sp.	20BSS04LM4	South Korea	Bat skin swab	ON545837	ON553461	ON614759	ON614780	ON707010
95	<i>Pseudogymnoascus</i> sp.	20BSS17OM1	South Korea	Bat skin swab	ON545838	ON553462	ON614761	ON614781	ON707011
96	<i>Pseudogymnoascus</i> sp.	20BSS17OM2	South Korea	Bat skin swab	ON545839	ON553463	ON614762	ON614782	ON707012

^a CBS: Culture collection of the Westerdijk Biodiversity Institute, Utrecht, the Netherlands; CGMCC: China General Microbiological Culture Collection Center, Beijing, China; GZUIFR: Herbarium of Guizhou Agricultural College, Institute of Fungus Resources, Guizhou University, China; CHFC: Chilean Fungal Collection, Facultad de Medicina, Universidad de Chile, Santiago, Chile; RMF : Rocky Mountain Fungi, IBT (Institut for Biotechnologi) Culture collection of Fungi, Lyngby, Denmark; WSF: Wisconsin Soil Fungi, IBT (Institut for Biotechnologi) Culture collection of Fungi, Lyngby, Denmark. UAMH: University of Alberta Microfungus Collection and Herbarium (UAMH) Centre for Global Microfungal Biodiversity, University of Toronto, Canada; VKM: All-Russian Collection of Microorganisms, Skryabin Institute of Biochemistry and Physiology of Microorganisms, Russian Academy of Science, Pushchino, Russia.

^b na = not available. ^c Some markers were extracted from sequenced genomes. In these cases, the GenBank accession number of the contig is given. Numbers in parentheses indicate the location of the sequence of interest in the contig (from nucleotide XX to XX).

References

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