

SI Species Richness versus the occurrence-weighted taxonomic composition

The unweighted species richness and lifestyle composition (S1 a and c) in comparison to the occurrence-weighted taxonomic and lifestyle composition (S1b and d), the less abundant taxa contribute more to the unweighted distributions (S1a and c). In Figure S1a, within the TSP species richness, this has led to the proportion of AMC reduced in the 3-sample-subset and increased in the 5-sample-subset compared to the entire dataset, whereas the occurrence-weighted (S1b) version displays a steady increase from the entire dataset over the 3- to the 5-sample-subsets. This can be explained by a high number of BMC with occurrences between 3 and 5 samples. Most prominently in the size fraction distributions of the 3-sample-subset (S1a), the BMC class of Agaricomycetes in the coarse and fine fraction are significantly increased in comparison to the occurrence-weighted version (S1c), indicating a high diversity and low individual taxon occurrence rate amongst the class. Furthermore, the Agaricomycetes coarse and fine proportions are reversed in the species richness version, with the coarse proportion (~66%) 11% higher than in the fine fraction (~55%) compared to a 7% increase in fine fraction seen in the occurrence weighted version, showing a higher diversity in coarse but a higher occurrence rate in the fine fraction. The high diversity and low occurrence rate of the Agaricomycetes furthermore explains the large increase of wood saprophytes in from the weighted (~20% Fig S1d) to the species richness version (~40% Fig S1c). The comparison also reveals an increase in the proportion of the taxa classified as plant pathogens or potential plant pathogens in the weighted version, irrespective of them being woody- or herbaceous-plant-fungi. This illustrates the high occurrence levels of the pathogenic fungi.

Figure S1

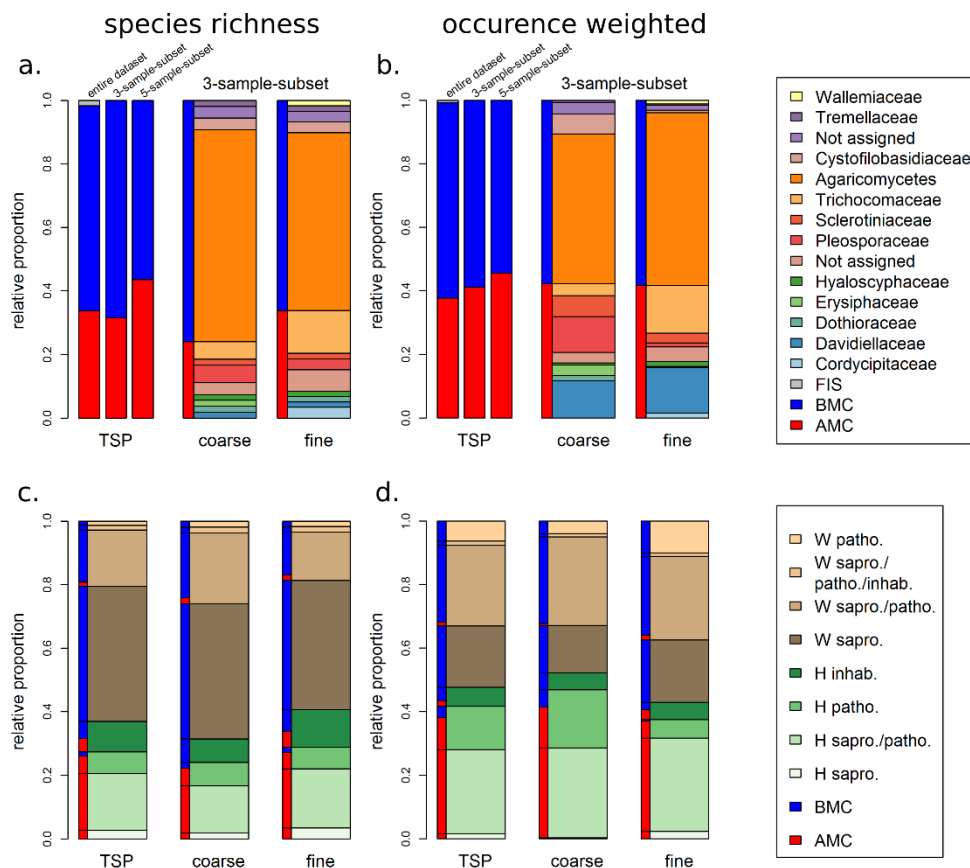


Figure S1: Comparison of the species richness (a) and occurrence-weighted taxonomic composition (b), next to the unweighted (c) and occurrence-weighted (d) lifestyle distributions in in total suspended particles (TSP) and the coarse and fine particle fractions. a. and c: TSP show the relative proportions on phylum level for the entire dataset, the 3-sample-subset and the 5-sample-subset. Coarse and fine show the relative proportions on family and phylum level (thin side bars) for the coarse and fine particle fraction of the 3-sample-subset. For reasons of clarity all families belonging to the class of Agaricomycetes have been pooled. AMC: Ascomycota, BMC: Basidiomycota, FIS: Fungi *Incertae Sedis*. b. and d: Classification distribution of the 3-sample-subset along with the corresponding phylum distribution of the individual groups (thin side bars). H: herbaceous-plant-associated, W: woody plant associated, sapro.: saprophytic, patho.: pathogenic, inhab.: surface inhabiting.

SI Influence of meteorology

Meteorological factors will influence the fungal life cycle, from hyphal growth up to spore formation and liberation, and will therefore ultimately also be major governing factors in the sporulation strategy. It was also found that different species of fungi display different hyphal growth optima dependent on temperature and water availability (Donnelly and Boddy, 1997; Dowson et al., 1989; van Laarhoven et al., 2015). When it comes to spore release different species show altering dependencies to relative humidity, wind speed and temperature (Jones and Harrison, 2004). Fungi that have active release mechanisms usually depend on an increase in relative humidity or water availability to discharge their spores (Elbert et al., 2007) while passively released spores, such as the conidia of mold fungi, usually depend on dry and turbulent conditions (Jones and Harrison, 2004). Moreover, insight into the influence of meteorological parameters on sporulation is of critical importance to understand and estimate the impacts of climate change, which is especially important for agriculture, due to the high abundance of fungal plant pathogens.

Figure S2 illustrates correlations between the RFO values of the 3-sample-subset and meteorological parameters, seen in Figure S3, in a Spearman's Rank coefficient heat map. A monthly time resolution was chosen to heighten the statistical robustness. The correlations, if a direct dependence is assumed, should be seen as a more long-term influence on the sporulation process, e.g., governing hyphal growth and spore formation, rather than short-term influences, such as, processes governing direct spore release. Of course, the sum of short-term influences may lead to long-term correlations, e.g., long periods of high wind speeds or optimal humidity levels heightening spore liberation and/or distance travelled through the atmosphere.

On a whole, temperature and wind speed show most of the stronger correlations. Relative humidity and precipitation show relatively few correlations to the RFO values. Previous studies found these two factors play significant roles in the sporulation process (24 and references therein). However, they primarily have more short-term influence on sporulation and atmospheric residence which may be masked by the grouping into months.

Again, taking the lifestyle classifications into account, distinct differences can be seen between the groups. The herbaceous-plant-associated fungi on a whole show more and stronger correlations. More specifically temperature seems to play a large role, which only shows weak correlations amongst the woody-plant-associated fungi. As discussed above, we believe the observed earlier sporulation onset seen in 2007, especially amongst the herbaceous-plant-associated fungi, was due to the warm wintertime temperatures of 2006/07. The observed correlations with temperature strengthen the assumption of a direct dependency. Having temperature as a governing factor makes sense for fungi with seasonal dispersal strategies, aimed at different stages in the vegetative cycle of plants. For the Aspergilli strong negative correlations are seen with temperature, which may indicate the species sampled are primarily saprophytic, increasing spore release with decreasing temperature to inoculate the fresh plant litter produced late in the year. The pathogenic *Itersonilia perplexans*, the cause of petal blight, also displays a negative correlation which may indicate a strategy aiming at infecting weakened hosts late in the year or a spread of spores ready for germination after winter dormancy. Strong positive correlations with temperature are seen for *Epicoccum* sp. and *Sporobolomyces coprosmae*. These two taxa seem to have a strategy of inoculating developing or developed vegetation during increasing early year temperatures.

In comparison the woody-plant-associated fungi seem to show weaker correlations. In TSP many of the taxa show the strongest correlations with wind speed and, more specifically, often the maximum wind speed. This observation might again be explained by the source habitats being the forests in 3.5-10 km distance to the sampler. High wind speeds should both aid transport out of the forest canopy and facilitate an atmospheric transport over longer distances. This would also explain the sporadic occurrences seen amongst the wood saprophytes in Figure 3, with high wind speeds being prerequisite for the spores reaching the sampling location.

When viewing the correlations within the coarse and fine fractions separately, again distinct differences can be observed between the lifestyle categories. The herbaceous-plant-associated pathogens and surface inhabitants show correlations almost exclusive to the coarse size fraction. This can be explained by Figure 4, as the coarse fine ratios of these groups are strongly shifted towards the coarse size fraction. Furthermore, the plant pathogens, viewed individually, display similar Spearman coefficient values when comparing coarse fraction to TSP, while the plant-surface-inhabiting fungi show more and stronger correlations in the coarse fraction. On the contrary the woody-plant-associated fungi display most correlations within the fine fraction with a few taxa displaying coarse fraction correlations. This again can be explained by Figure 4 as the woody-plant-associated fungi on a whole display a slight shift toward the fine fraction. The size-dependent differences observed between the coarse and

fine fraction correlations do, to a certain extent, reduce the probability that the observed correlations are merely coincidental, even though the correlations seen in TSP are of a higher relevance, so the meteorological influence on the atmospheric presence of the taxa regardless of the size fraction.

Figure S2 Meteorological correlations

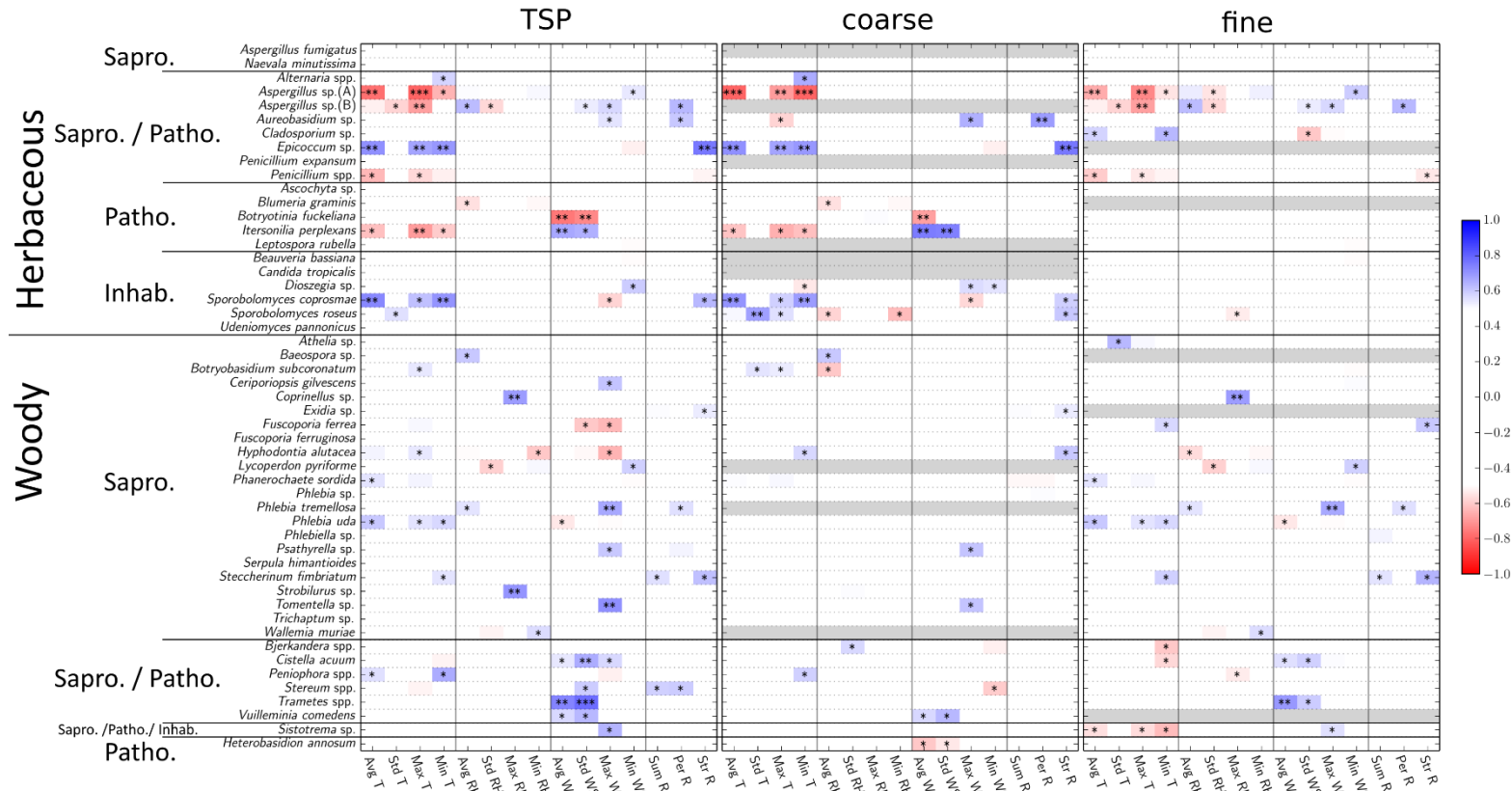
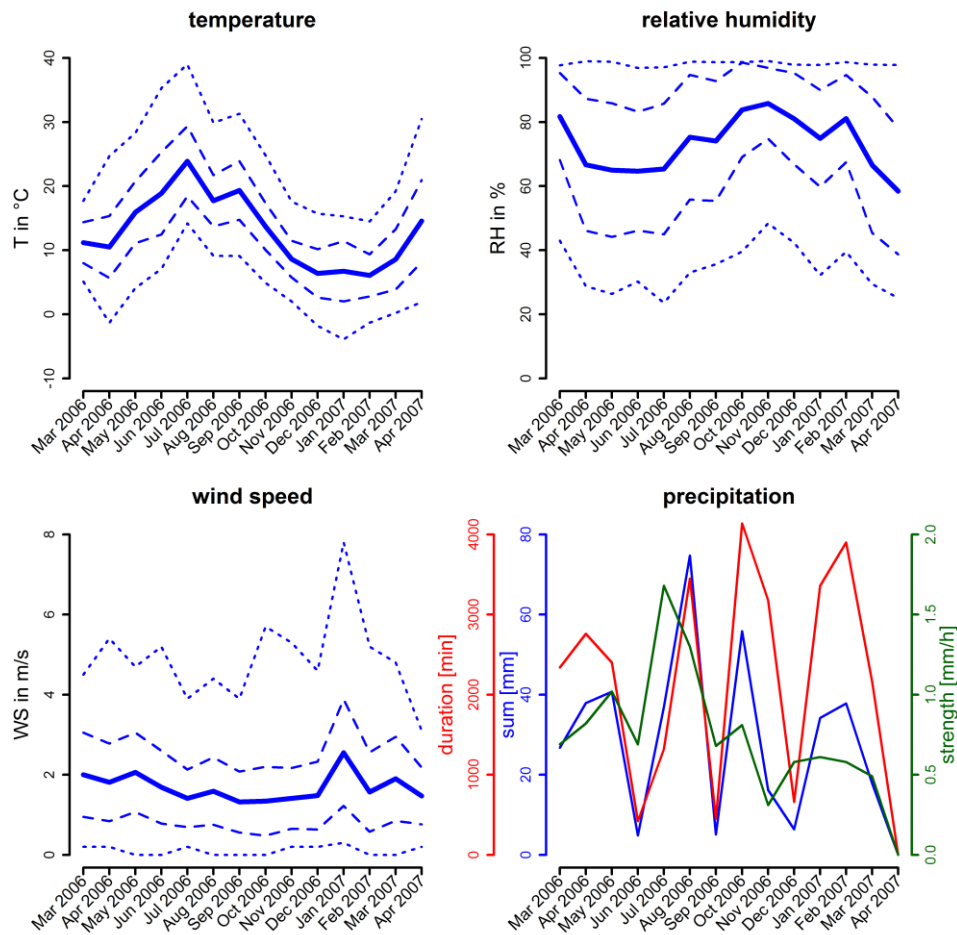


Figure S2: A Spearman's rank correlation matrix between the RFO values of all taxa in the 3-sample-subset (figure 4) and meteorological factors (shown in supplementary figure S3). An individual matrix is shown for TSP, coarse and fine fraction. The values range from blue (+1) to red (-1), indicating a monotone increase or decrease, respectively, between the compared variables. Furthermore, a color scheme was chosen that begins coloration outside of threshold of -0.5 to 0.5 to disregard insignificant correlations. The grey shading indicates the absence the taxon was not in the respective size fraction. The p-value is the probability of a random dataset of the same size producing the same results (** < 0.05; *** < 0.01; **** < 0.001).

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Figure S3 Meteorological factors



5 **Figure S3: Overview of the meteorological factors used for the correlation analysis seen in figure S2. The values were calculated by grouping the values that lay within the sampling periods of the individual months. For temperature, relative humidity and wind speed the solid lines represent the averages, the dashed lines the standard deviation and the dotted lines the maxima and minima. For precipitation the line colors correspond to the three different y-axes.**

Table S1 Subset taxa

Table S1: Overview of the species and genera in the 3-sample-subset (all) and 5-sample-subset (blue). The OTUs refer to the IDs used in Fröhlich-Nowoisky et al., 2009. Furthermore, the taxonomy, two order lifestyle classifications, occurrences in the TSP, coarse and fine fractions and used spore dimensions; length (l) and width (w) are provided. The taxonomic ranks were from the Catalogue of Life database (Bisby et al., 2010). Oftentimes taxon spore sizes and information were found in the Mycobank database (Robert et al., 2013) from which the citations were extracted.

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Taxon	Taxonomy	OTUs	Lifestyle Classification		Occurrences			Spore Sizes (l)x(w) in μm	Literature (Size)
			First Order	Second Order	TSP	Coarse	Fine		
<i>Cladosporium</i> sp.	Davidiellaceae, Capnodiales, Dothideomycetes, Ascomycota	AMC1	herbaceous	sapro, path	41	35	37	(3 - 35)x(2 - 10)	(Al-Doory and Domson, 1984)
<i>Botryotinia fuckeliana</i>	Sclerotiniaceae, Helotiales, Leotiomycetes, Ascomycota	AMC2	herbaceous	path	24	20	8	(9 - 12)x(7 - 10)	(Gilman, 1957)
<i>Epicoccum</i> sp.	Pleosporaceae, Pleosporales, Dothideomycetes, Ascomycota	AMC3	herbaceous	sapro, path	18	18	0	(12 - 21)	(Schol-Schwarz, 1959)
<i>Aspergillus</i> sp.(A)	Trichocomaceae, Eurotiales, Eurotiomycetes, Ascomycota	AMC4	herbaceous	sapro, path	13	7	7	(2.5 - 10)	(Noble et al., 1963)
<i>Alternaria</i> spp.	Pleosporaceae, Pleosporales, Dothideomycetes, Ascomycota	AMC5, AMC10	herbaceous	sapro, path	18	16	3	(18 - 83)x(7 - 18)	(Al-Doory and Domson, 1984)
<i>Penicillium</i> spp.	Trichocomaceae, Eurotiales, Eurotiomycetes, Ascomycota	AMC8, AMC67, AMC105, AMC106, AMC108	herbaceous	sapro, path	12	4	11	(2 - 8)	(Martinez et al., 1982)
<i>Penicillium expansum</i>	Trichocomaceae, Eurotiales, Eurotiomycetes, Ascomycota	AMC6	herbaceous	sapro, path	12	0	12	(3 - 3.5)	(De Hoog, 2000)
<i>Ascochyta</i> sp.	Not assigned, Pleosporales, Dothideomycetes, Ascomycota	AMC7	herbaceous	path	11	9	3	(6 - 16)x(3.4 - 5.6)	(Kovachevski, 1936)
<i>Blumeria graminis</i>	Erysiphaceae, Erysiphales, Leotiomycetes, Ascomycota	AMC9	herbaceous	path	10	10	0	(25 - 38)x(10 - 17)	(Sperr, 1973)

<i>Aureobasidium</i> sp.	Dothioraceae, Dothideales, Dothideomycetes, Ascomycota	AMC12	herbaceous	sapro, path	6	5	1	(7 - 13)x(3 - 6.5)	(Kockova- Kratochvilova et al., 1980)
<i>Cistella acuum</i>	Hyaloscyphaceae, Helotiales, Leotiomycetes, Ascomycota	AMC13	woody	sapro, path	6	2	4	(3 - 20)x(1 - 5)	(Petersen and Læssøe, n.d.)
<i>Aspergillus</i> sp.(B)	Trichocomaceae, Eurotiales, Eurotiomycetes, Ascomycota	AMC15	herbaceous	sapro, path	5	0	5	(2.5 - 10)	(Noble et al., 1963)
<i>Aspergillus fumigatus</i>	Trichocomaceae, Eurotiales, Eurotiomycetes, Ascomycota	AMC17	herbaceous	sapro	4	0	4		
<i>Candida tropicalis</i>	Not assigned, Saccharomycetales, Saccharomycetes, Ascomycota	AMC18	herbaceous	inhab	4	0	4		
<i>Naevula minutissima</i>	Not assigned, Helotiales, Leotiomycetes, Ascomycota	AMC20	herbaceous	sapro	3	1	2		
<i>Leptospora rubella</i>	Not assigned, Not assigned, Dothideomycetes, Ascomycota	AMC21	herbaceous	path	3	0	3		
<i>Beauveria bassiana</i>	Cordycipitaceae, Hypocreales, Sordariomycetes, Ascomycota	AMC22, AMC101	herbaceous	inhab	4	0	4		
<i>Heterobasidion annosum</i>	Bondarzewiaceae, Russulales, Agaricomycetes, Basidiomycota	BMC1	woody	path	30	12	26	(4.5 - 6.5)x(3.5 - 4.5)	(Petersen and Læssøe, n.d.)
<i>Bjerkandera</i> spp.	Meruliaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC2, BMC214	woody	sapro, path	30	22	22	(4 - 5)x(2 - 3)	(Shaw and Forest, 1988)
<i>Trametes</i> spp.	Polyporaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC3, BMC10	woody	sapro, path	29	18	23	(4.5 - 6.5)x(1.5 - 2.5)	(Ryvarden and Johansen, 1980)
<i>Peniophora</i> spp.	Peniophoraceae, Russulales, Agaricomycetes, Basidiomycota	BMC4, BMC17, BMC57, BMC75, BMC137	woody	sapro, path	22	15	9	(6.5 - 8)x(3 - 3.5)	(Whelden, 1936)
<i>Stereum</i> spp.	Stereaceae, Russulales, Agaricomycetes, Basidiomycota	BMC5, BMC30	woody	sapro, path	20	14	10	(5 - 12)x(2 - 4)	(Eriksson et al., 1978)

<i>Itersonilia perplexans</i>	Cystofilobasidiaceae, Cystofilobasidiales, Tremellomycetes, Basidiomycota	BMC6	herbaceous	path	17	16	1	(12.5 - 17)x(6 - 9)	(Ingold, 1983)
<i>Vuilleminia comedens</i>	Corticiaceae, Corticiales, Agaricomycetes, Basidiomycota	BMC7	woody	sapro, path	13	13	0	(18 - 23)x(5 - 7)	(Bernicchia and Gorjón, 2010)
<i>Phlebia</i> sp.	Meruliaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC8	woody	sapro	12	6	7	(3.5 - 4.5)x(1.5 - 2)	(Bridge Cooke, 1956)
<i>Sporobolomyces roseus</i>	Not assigned, Sporidiobolales, Microbotryomycetes, Basidiomycota	BMC9	herbaceous	inhab	8	7	3	(7 - 14)x(3 - 6)	(Ramírez Gómez, 1957)
<i>Botryobasidium subcoronatum</i>	Botryobasidiaceae, Cantharellales, Agaricomycetes, Basidiomycota	BMC11	woody	sapro	7	5	4	(8 - 12)x(5 - 7)	(Donk, 1931)
<i>Sistotrema</i> sp.	Hydnaceae, Cantharellales, Agaricomycetes, Basidiomycota	BMC12	woody	sapro, path, inhab	6	3	3	(2.7 - 3.7)x(2.3 - 3)	(Münzenberger et al., 2012)
<i>Sporobolomyces coprosmae</i>	Not assigned, Sporidiobolales, Microbotryomycetes, Basidiomycota	BMC14	herbaceous	inhab	5	4	1	(2.5 - 5)x(2 - 2.5)	(Hamamoto and Nakase, 1995)
<i>Phanerochaete sordida</i>	Phanerochaetaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC15, BMC32	woody	sapro	6	3	3	(5 - 7)x(2.5 - 3)	(Eriksson et al., 1978)
<i>Steccherinum fimbriatum</i>	Meruliaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC16	woody	sapro	5	1	4	(3 - 3.5)x(2 - 2.5)	(Bernicchia and Gorjón, 2010)
<i>Fuscoporia ferrea</i>	Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Basidiomycota	BMC19	woody	sapro	4	3	2		
<i>Serpula himantioides</i>	Serpulaceae, Boletales, Agaricomycetes, Basidiomycota	BMC21	woody	sapro	4	3	1		
<i>Udeniomyces pannonicus</i>	Cystofilobasidiaceae, Cystofilobasidiales, Tremellomycetes, Basidiomycota	BMC22	herbaceous	inhab	4	3	1		

<i>Hyphodontia alutacea</i>	Schizoporaceae, Hymenochaetales, Agaricomycetes, Basidiomycota	BMC23	woody	sapro	4	2	2
<i>Phlebia tremellosa</i>	Meruliaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC24	woody	sapro	4	0	4
<i>Baeospora</i> sp.	Marasmiaceae, Agaricales, Agaricomycetes, Basidiomycota	BMC26	woody	sapro	3	3	0
<i>Strobilurus</i> sp.	Physalacriaceae, Agaricales, Agaricomycetes, Basidiomycota	BMC28	woody	sapro	3	2	1
<i>Psathyrella</i> sp.	Psathyrellaceae, Agaricales, Agaricomycetes, Basidiomycota	BMC29	woody	sapro	3	2	1
<i>Fuscoporia ferruginosa</i>	Hymenochaetaceae, Hymenochaetales, Agaricomycetes, Basidiomycota	BMC33, BMC156	woody	sapro	4	3	1
<i>Dioszegia</i> sp.	Tremellaceae, Tremellales, Tremellomycetes, Basidiomycota	BMC34	herbaceous	inhab	3	2	1
<i>Phlebia uda</i>	Meruliaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC35	woody	sapro	3	1	3
<i>Coprinellus</i> sp.	Psathyrellaceae, Agaricales, Agaricomycetes, Basidiomycota	BMC37, BMC200	woody	sapro	4	1	3
<i>Ceriporiopsis gilvescens</i>	Phanerochaetaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC38	woody	sapro	3	1	2
<i>Phlebiella</i> sp.	Not assigned, Polyporales, Agaricomycetes, Basidiomycota	BMC39	woody	sapro	3	1	2
<i>Wallemia muriae</i>	Wallemiaceae, Wallemiales, Wallemiomycetes, Basidiomycota	BMC40	woody	sapro	3	0	3
<i>Lycoperdon pyriforme</i>	Agaricaceae, Agaricales, Agaricomycetes, Basidiomycota	BMC42	woody	sapro	3	0	3
<i>Exidia</i> sp.	Auriculariaceae, Auriculariales, Agaricomycetes, Basidiomycota	BMC49, BMC129	woody	sapro	3	3	0

<i>Trichaptum</i> sp.	Polyporaceae, Polyporales, Agaricomycetes, Basidiomycota	BMC52, BMC216	woody	sapro	3	2	1
<i>Athelia</i> sp.	Atheliaceae, Atheliales, Agaricomycetes, Basidiomycota	BMC59, BMC194, BMC195	woody	sapro	4	1	3
<i>Tomentella</i> sp.	Telephoraceae, Thelephorales, Agaricomycetes, Basidiomycota	BMC97, BMC126, BMC210	woody	sapro	3	2	1

Table S2 Statistical abbreviations and formula

Symbol	Definition
BC_{ij}	Bray Curtis Dissimilarity Index between sample i and j
C_{ij}	common OTUs found on sample i and j
$S_{i/j}$	number of OTUs found on sample i or j
	$BC_{ij} = 1 - \frac{2C_{ij}}{S_i + S_j}$
\bar{S}	coarse-fine ratio
$S_{tot/c/f}$	number of occurrences <i>tot</i> : In total; <i>c</i> : in the coarse fraction; <i>f</i> : in the fine fraction
	$\bar{S} = \frac{S_c - S_f}{S_{tot}}$
d_{vol}	volumetric equivalent diameter
d_a	aerodynamic diameter
w, l	spore width and length
K	dynamic shape correction factor
q	spore length to width ratio
ρ_0	unit density (1 g cm ⁻³)
ρ_{spore}	spore density

$$d_{vol} = (w^2 \times l)^{\frac{1}{3}}$$

$$\kappa = \frac{8}{3} \frac{q^{-1/3}}{\left\{ \frac{q}{(q^2 - 1)} + \frac{1}{\sqrt{q^2 - 1}} \left[1 - \frac{1}{2(q^2 - 1)} \right] \ln \left(\frac{q + \sqrt{q^2 - 1}}{q - \sqrt{q^2 - 1}} \right) \right\}}$$

$$d_a = \sqrt{\frac{\rho_{spore}}{\rho_0 K}} d_{vol}$$

$RFO_{x,y}$ Relative Frequency of Occurrence for taxon x in time period y

$N_{x,y}$ Number of samples tested positive for taxon x in time period y

$N_{tot,y}$ Number of total samples taken in time period y

$$RFO_{x,y} = \frac{N_{x,y}}{N_{tot,y}}$$

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