

**Table S2.** Description of the topological congruence/incongruence of the phylogenetic inferences shown in main Fig. 3A–D.

		Genetic loci analyzed			
		LSU (28S)	nuSSU (18S)	mtSSU (16S)	combined
Orders	<i>Pyrenulales</i> (= outgroup)	monophyletic, fully supported*	monophyletic, supported	monophyletic, fully supported	monophyletic, fully supported
	<i>Phaeomoniellales</i> (including cl. I <sup>#</sup> )	monophyletic, fully supported, basal in <i>Chaetothyriomycetidae</i>	monophyletic, supported*, basal in <i>Chaetothyriomycetidae</i>	monophyletic, fully supported, nested in <i>Chaetothyriomycetidae</i>	monophyletic, fully supported, basal of <i>Chaetothyriales</i>
	<i>Verrucariales</i>	monophyletic, fully supported, closely related to <i>Muellerella</i> spp. 1, cl. IV and cl. V	monophyletic, supported, basal of <i>Chaetothyriales</i>	monophyletic, fully supported, closely related to <i>Muellerella</i> spp. 1, <i>Muellerella</i> spp. 2, cl. IV, cl. V and <i>Phaeomoniellales</i>	monophyletic, fully supported, supported sister of <i>Muellerella</i> spp. 2
	<i>Chaetothyriales</i>	monophyletic, fully supported	monophyletic, unsupported, missing <i>Epibryaceae</i> (1)	paraphyletic, unsupported, splitting into three lineages <i>Chaetothyriales</i> (1), (2) and (3)	monophyletic, supported
Families of <i>Chaetothyriales</i>	<i>Chaetothyriaceae</i>	monophyletic, supported, inside <i>Chaetothyriales</i>	monophyletic, supported, inside <i>Chaetothyriales</i>	not represented	monophyletic, fully supported, inside <i>Chaetothyriales</i>
	<i>Cyphellophoraceae</i>	monophyletic, supported, inside <i>Chaetothyriales</i>	monophyletic, unsupported, nested in <i>Herpotrichiellaceae</i>	monophyletic, unsupported, representing <i>Chaetothyriales</i> (3)	monophyletic, fully supported, inside <i>Chaetothyriales</i>
	<i>Epibryaceae</i>	paraphyletic as <i>Epibryaceae</i> (1) and (2), supported, basal in <i>Chaetothyriales</i>	polyphyletic, supported	paraphyletic, fully supported, at base of clade <i>M. atricola</i> + <i>M. lichenicola</i> / <i>Lichenodiplis</i> -like anamorph	monophyletic, supported, basal in <i>Chaetothyriales</i>
	<i>Herpotrichiellaceae</i>	paraphyletic, supported and unsupported, inside <i>Chaetothyriales</i>	monophyletic, unsupported, inside <i>Chaetothyriales</i>	monophyletic, fully supported, inside <i>Chaetothyriales</i> (1)	monophyletic, supported, inside <i>Chaetothyriales</i>
	<i>Trichomeriaceae</i>	monophyletic, fully supported, inside <i>Chaetothyriales</i>	monophyletic, unsupported, inside <i>Chaetothyriales</i>	monophyletic, supported, closely related to cl. VI+VII <sup>#</sup> , forming <i>Chaetothyriales</i> (2)	monophyletic, fully supported, inside <i>Chaetothyriales</i>
<i>Muellerella</i> lineages	<i>M. atricola</i> + <i>M. lichenicola</i> / <i>L. lecanorae</i> -like anamorph (Muggia et al. 2015)	monophyletic, fully supported*, inside <i>Chaetothyriales</i>	monophyletic, supported, nested within <i>Chaetothyriales</i>	monophyletic, fully supported, nested in <i>Chaetothyriales</i> (1)	monophyletic, fully supported, inside <i>Chaetothyriales</i>
	<i>Muellerella</i> spp. 1	monophyletic, unsupported, supported sister of cl. IV <sup>#</sup>	monophyletic, supported, unresolved	monophyletic, fully supported, closely related to cl. IV and cl. V	monophyletic, fully supported, supported sister of cl. IV
	<i>Muellerella</i> spp. 2	monophyletic, fully supported*, nested in <i>Verrucariales</i>	monophyletic, fully supported*, inside <i>Chaetothyriales</i>	monophyletic, fully supported*, sister to <i>Phaeomoniellales</i>	monophyletic, fully supported, supported sister of <i>Verrucariales</i>
Other lineages <sup>#</sup>	cl. I	monophyletic, fully supported, inside <i>Phaeomoniellales</i>	monophyletic, supported, inside <i>Phaeomoniellales</i>	monophyletic, supported, inside <i>Phaeomoniellales</i>	monophyletic, fully supported, inside <i>Phaeomoniellales</i>
	cl. IV	monophyletic, fully supported, sister to <i>Muellerella</i> spp. 1	monophyletic, fully supported, basal of <i>Verrucariales</i> and <i>Chaetothyriales</i>	monophyletic, supported, closely related to cl. V and <i>Muellerella</i> spp. 1	monophyletic, fully supported, sister of <i>Muellerella</i> spp. 1
	cl. V	monophyletic, unsupported, closely related to cl. IV and <i>Muellerella</i> spp. 1	monophyletic, unsupported, basal of <i>Verrucariales</i> and <i>Chaetothyriales</i>	paraphyletic, unsupported, nested with cl. IV and <i>Muellerella</i> spp. 1	paraphyletic, closely related to cl. IV and <i>Muellerella</i> spp. 1
	cl. VI+VII	monophyletic, fully supported, inside <i>Chaetothyriales</i>	monophyletic, supported, inside <i>Chaetothyriales</i>	monophyletic, fully supported, closely related to <i>Trichomeriaceae</i> forming <i>Chaetothyriales</i> (2)	monophyletic, fully supported, inside <i>Chaetothyriales</i>