



Introducing the Consolidated Species Concept to resolve species in the *Teratosphaeriaceae*

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Key words

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species concepts
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Abstract The *Teratosphaeriaceae* represents a recently established family that includes numerous saprobic, extremophilic, human opportunistic, and plant pathogenic fungi. Partial DNA sequence data of the 28S rRNA and RPB2 genes strongly support a separation of the *Mycosphaerellaceae* from the *Teratosphaeriaceae*, and also provide support for the *Extremaceae* and *Neodevriesiaceae*, two novel families including many extremophilic fungi that occur on a diversity of substrates. In addition, a multi-locus DNA sequence dataset was generated (ITS, LSU, Btub, Act, RPB2, EF-1 α and Cal) to distinguish taxa in *Mycosphaerella* and *Teratosphaeria* associated with leaf disease of *Eucalyptus*, leading to the introduction of 23 novel genera, five species and 48 new combinations. Species are distinguished based on a polyphasic approach, combining morphological, ecological and phylogenetic species concepts, named here as the Consolidated Species Concept (CSC). From the DNA sequence data generated, we show that each one of the five coding genes tested, reliably identify most of the species present in this dataset (except species of *Pseudocercospora*). The ITS gene serves as a primary barcode locus as it is easily generated and has the most extensive dataset available, while either Btub, EF-1 α or RPB2 provide a useful secondary barcode locus.

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INTRODUCTION

The current generic and family concepts of the *Mycosphaerellaceae* and the *Teratosphaeriaceae* (*Capnodiales*, *Dothideomycetes*) can be indirectly attributed to Crous (1998), who used morphological characteristics of cultures and asexual morphs to show that *Mycosphaerella* was polyphyletic. Crous (1998) suggested that the genus warranted subdivision into natural groups, defined by their asexual morphs. In contrast to these findings, the first phylogenetic trees published for *Mycosphaerella* (based on ITS nrDNA sequence data), showed it was monophyletic (Crous et al. 1999, 2000, 2001, Stewart et al. 1999, Goodwin et al. 2001). As more sequence data became available (especially of loci such as 28S nrDNA), this view gradually changed and *Mycosphaerella* is now recognised as polyphyletic (Braun et al. 2003, Schubert et al. 2007, Crous et al. 2007b, 2009b, Batzer et al. 2008, Dugan et al. 2008, Bensch et al. 2012). Although *Mycosphaerella* s.l. represents a complex (of genera and species) with more than 10 000 species names (Crous et al. 2000, 2001, 2004b, c, 2006, 2007a, 2009c, Crous & Braun 2003), several phylogenetic lineages remain poorly resolved due to limited sampling (Hunter et al. 2006, Crous et al. 2007a, 2009a–d, Quaedvlieg et al. 2011, 2012). A previous study by Verkley et al. (2004) showed that *Mycosphaerella* s.str. was limited to species with *Ramularia* asexual morphs, and that

the remaining *Mycosphaerella*-like species were better placed in other genera.

The genus *Teratosphaeria* was separated from *Mycosphaerella* s.l. based on its ascomatal arrangement and periphysate ostioles (Müller & Oehrens 1982). *Teratosphaeria* was later placed in its own family, based on ascospores that turn brown and verruculose while still in their asci, the presence of pseudo-parenchymatal remnants in ascomata, ascospores with mucoid sheaths, distinct asexual morphs and DNA phylogenetic data (Crous et al. 2007a). By 2012, 22 asexual extremophilic and plant pathogenic genera have been linked to the *Teratosphaeriaceae*, while 38 asexual genera were included in the *Mycosphaerellaceae* (Hyde et al. 2013). Another 11 genera have subsequently been added to the *Mycosphaerellaceae* (Crous et al. 2013, Quaedvlieg et al. 2013). Recent phylogenetic studies into extremophilic fungi collected by Friedman (1982) and Selbmann (2005, 2008) have shown that several genera of slow-growing melanised rock-inhabiting (extremophilic) fungi, isolated from harsh climatic conditions (e.g. the South Pole and high mountain peaks) either belong to the *Teratosphaeriaceae* and/or to a closely associated, unclassified, family referred to as either *Teratosphaeriaceae* '1' or '2' in Ruibal et al. (2009, 2011) and Egidi et al. (2014).

The original concept of *Mycosphaerella* has shifted as it became evident that the mycosphaerella-like morphology has evolved multiple times with taxa clustering in disparate families such as the *Schizothyriaceae* (Batzer et al. 2008), *Cladosporiaceae* (Schubert et al. 2007, Dugan et al. 2008, Bensch et al. 2010, 2012), *Dissoconiaceae*, *Mycosphaerellaceae* and *Teratosphaeriaceae* (Crous et al. 2009b, Li et al. 2012).

Numerous species are associated with *Mycosphaerella* leaf disease (MLD) and *Teratosphaeria* leaf disease (TLD) of *Eucalyptus* and the closely related genus *Corymbia*. The genus *Eucalyptus* (*Myrtaceae*) is primarily native to Australia and contains more than 700 species. Some species have exceptionally

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fast growth rates and relatively short rotation periods, making them ideally suited for hardwood timber, firewood, charcoal, essential oils and pulp production (Grattapaglia et al. 2012). For commercial purposes, *Eucalyptus* spp. have been introduced and cultivated in many other tropical, sub-tropical and temperate countries, where these species often prosper and even dominate a range of habitats, from heathlands to forests (Crous 1998, Turnbull 2000, Wingfield et al. 2001, Boland et al. 2006). Although *Eucalyptus* spp. exhibit many properties favourable for commercial forestry production, exotic plantations often suffer severe damage caused by the large numbers of native (host-shift) and introduced pathogens that may cause serious and epidemic diseases, often simultaneously on roots, stems or leaves (Park et al. 2000, Old et al. 2003, Slippers et al. 2005, Hunter et al. 2011). A good example of host shifting is the stem canker pathogen *Teratosphaeria zuluensis*, which most likely jumped from a native tree to introduced clones of *E. grandis* in South Africa and to *E. camaldulensis* in Ethiopia, where it is now a major pathogen (Wingfield et al. 1996, Gezaghne et al. 2003, Cortinas et al. 2010). Host jumping by fungal pathogens is relatively common and several other examples can be found among fungal species associated with MLD and TLD of eucalypts (Crous & Groenewald 2005, Burgess et al. 2007, Crous et al. 2007a, Arzanlou et al. 2008, Hunter et al. 2011, Pérez et al. 2013).

In total, more than 146 species in the *Mycosphaerellaceae* and *Teratosphaeriaceae* cultivated from leaf spots of eucalypts are included in this study. Species of this complex are assemblages of cryptic taxa that can co-inhabit the same lesions, making reliable species identification difficult (Crous 1998, Barnes et al. 2004, Crous et al. 2004b, c, Groenewald et al. 2005, Cheewangkoon et al. 2008, Stukenbrock et al. 2012). Species identification has been hampered by conserved sexual morphologies throughout the *Mycosphaerellaceae* and the *Teratosphaeriaceae*, turning the taxonomic and systematic focus mostly to asexual morphology (Crous et al. 2000, 2006, Verkley et al. 2013). However, similar asexual morphologies have also independently evolved in different taxa, further complicating the taxonomy of these pathogens (Crous et al. 2007a).

The introduction of routine DNA sequencing technology during the last decade has made it possible to mostly identify and classify these phytopathogens, although species boundary ambiguities still exist between phylogenetically closely related taxa. Several previous studies have used molecular sequencing techniques to analyse the diversity of MLD and TLD pathogens on *Eucalyptus* spp. However, these studies generally included a limited and frequently non-overlapping dataset of species and DNA loci (with ITS being used predominantly for species identification) (for example, Crous et al. 2006, Hunter et al. 2006).

We analyse 329 isolates representing 146 species of MLD- and TLD-associated fungi, using seven loci that have individually or in combination been used in the past to successfully identify species belonging to the *Mycosphaerellaceae* or *Teratosphaeriaceae*. These loci include partial sequences of the β -tubulin gene (Btub), the internal transcribed spacer regions and intervening 5.8S rDNA (ITS), actin (Act), translation elongation factor 1-alpha (EF-1 α), 28S nrDNA (LSU), calmodulin (Cal) and RNA polymerase II second largest subunit gene (RPB2) (Crous et al. 2004c, Hunter et al. 2006, Quaedvlieg et al. 2011). An additional 172 isolates representing 125 species (mostly extremophiles linked to the *Teratosphaeriaceae* by Ruibal et al. (2009, 2011) and Egidi et al. (2014) were also investigated based on two loci, LSU and RPB2.

The primary goal of this study is to 1) resolve the main lineages in *Teratosphaeriaceae* into phylogenetic and morphological units, which can be assigned to single generic names using

existing and newly generated LSU and RPB2 sequence data in combination with the LSU/RPB2 data of *Teratosphaeriaceae* associated extremophilic isolates generated by Ruibal et al. (2009, 2011) and Egidi et al. (2014). Secondary goals of this study are to 2) create a multi-locus DNA sequence dataset in order to rigorously distinguish the selected MLD- and TLD-associated fungal species; and 3) determine which loci provide the most reliable identification based on PCR efficiency and the size of the Kimura-2-parameter barcode gaps. Comparing the obtained results with existing literature, this study 4) describes novel species isolated from MLD and TLD symptoms; and 5) considers species boundaries of phylogenetically closely related taxa.

MATERIALS AND METHODS

Isolates

Isolates used for this study (Table 1) were obtained from the CBS-KNAW Fungal Biodiversity Centre, Utrecht, The Netherlands (CBS), or from the working collection of Pedro Crous (CPC), housed at CBS. Fresh collections were made from leaves of diverse hosts by placing material in damp chambers for 1–2 d. Single conidial colonies were grown from sporulating conidiomata on Petri dishes containing 2 % malt extract agar (MEA) as described earlier by Crous et al. (1991). Leaf and stem tissue bearing ascomata were soaked in water for \pm 2 h, after which they were placed in the bottom of Petri dish lids, with the top half of the dish containing MEA. Ascospore germination patterns were determined after 24 h, and single ascospore and conidial cultures were established according to Crous (1998). Colonies were sub-cultured onto potato-dextrose agar (PDA), oatmeal agar (OA) (see Crous et al. 2009e), MEA, and pine needle agar (PNA) (Smith et al. 1996), and incubated at 25 °C to promote sporulation.

Multi-locus DNA screening

Genomic DNA was extracted from mycelium growing on MEA (Table 1), using the UltraClean™ Microbial DNA Isolation Kit (Mo Bio Laboratories, Inc., Solana Beach, CA, USA). All strains were screened for seven loci (ITS, LSU, Act, Cal, EF-1 α , RPB2 and Btub) using the primer sets listed in Table 2. The PCR amplifications were performed in a total volume of 12.5 μ L solution containing 10–20 ng of template DNA, 1 \times PCR buffer, 0.7 μ L DMSO (99.9 %), 2 mM MgCl₂, 0.4 μ M of each primer, 25 μ M of each dNTP and 1.0 U BioTaq DNA polymerase (Bioline GmbH Luckenwalde, Germany). PCR conditions were set as follows: an initial denaturation temperature of 96 °C for 2 min, followed by 40 cycles of denaturation temperature of 96 °C for 45 s, primer annealing at the temperature stated in Table 2, primer extension at 72 °C for 90 s and a final extension step at 72 °C for 2 min. The resulting fragments were sequenced using the PCR primers and the BigDye Terminator Cycle Sequencing Kit v. 3.1 (Applied Biosystems, Foster City, CA, USA). Sequencing reactions were performed as described by Cheewangkoon et al. (2008).

Phylogenetic analysis

An initial alignment of the obtained sequence data was first done using MAFFT v. 7 (<http://mafft.cbrc.jp/alignment/server/index.html>; Katoh et al. 2002) and whenever indicated, manually improved in BioEdit v. 7.0.5.2 (Hall 1999). To check the congruency of the datasets, a 70 % Neighbour-Joining (NJ) reciprocal bootstrap method with maximum likelihood distance was performed on each individual locus (Mason-Gamer & Kellogg 1996) (resulting trees not shown). Bayesian analyses (critical

Table 1 Collection details and GenBank accession numbers of isolates included in this study.

Species	Isolate no. ^{1,2}	Host	Location	Collector	GenBank accession no. ³							
					LSU	Act	Cal	ITS	RPB2	EF-1 α	Btub	
<i>Acidella bohemica</i>	CBS 132720 CBS 132721 ^{ET} CBS 110500 ^{ET} of <i>Mycosphaerella aurantia</i> CBS 110843 = CPC 850 ^{ET} of <i>Mycosphaerella ellipsoides</i> CBS 116154 = CPC 794 ^{ET} of <i>Mycosphaerella africana</i> CPC 680.95 = CPC 796 ^{ET} of <i>Mycosphaerella africana</i>	Highly acidic soil Highly acidic soil <i>Eucalyptus globulus</i> <i>Eucalyptus cladocalyx</i> <i>Eucalyptus viminalis</i> <i>Eucalyptus viminalis</i>	Czech Republic Czech Republic Australia: Western Australia South Africa South Africa South Africa	M. Hujislová M. Hujislová A. Maxwell P.W. Crous P.W. Crous P.W. Crous	KF901984 KF901985 KF901837 KF902049 KF902047 KF902048	– – KF903395 KF903407 KF903480 KF903589	– – KF902554 KF902557 KF902555 KF902556	– – KF901516 KF901702 KF901700 KF901701	– – KF902178 KF902179 KF902223 KF902226 KF902224 KF902225	– – KF903115 KF903118 KF903116 KF903117	– – KF902818 KF902821 KF902819 KF902820	
<i>Apenidiella strumelloidea</i>	CBS 114484 ^{ET}	<i>Carex</i> sp.	Russia	S. Ozerskaya	KF937229	–	–	–	KF937266	–	–	–
<i>Aulographina pinorum</i>	CBS 655.86	<i>Pinus montana</i>	Switzerland	E. Müller	KF902102	–	–	–	KF902180	–	–	–
<i>Austroafricana associata</i>	CBS 112224 = CPC 3116 CBS 120730 = CPC 13119 ^{ET} CBS 120731 = CPC 13128 CBS 120732 = CPC 13108 CPC 13113 CPC 13375 CBS 130524 ^{ET}	<i>Protea lepidocarpodendron</i> <i>Corymbia henryi</i> <i>Corymbia variegata</i> <i>Eucalyptus dunni</i> <i>Eucalyptus dunni</i> <i>Eucalyptus tereticornis</i> <i>Eucalyptus globulus</i> × <i>camaldulensis</i>	Australia: New South Wales Australia: New South Wales Australia: New South Wales Australia: New South Wales Australia: New South Wales Australia: New South Wales Australia: Queensland	P.W. Crous & B. Summerell A.J. Carnegie A.J. Carnegie A.J. Carnegie A.J. Carnegie B. Summerell A.J. Carnegie	KF901827 KF901824 KF901828 KF901829 KF901825 KF901826 KF901830	– KF903526 KF903527 – – – –	– KF902528 KF902531 KF902532 KF902529 KF902530 –	– KF901510 KF901507 KF901511 KF901512 KF901508 KF901509	– KF902183 KF902177 KF902184 KF902185 KF902181 KF902182 KF902187	– KF903090 KF903087 KF903091 – KF902794 KF902791 KF902792 –	– KF902793 KF902790 – – – – –	
<i>A. parva</i>	CBS 110503 = CMW 14459 CBS 114761 = CPC 1217 CBS 116289 = CPC 10935 CBS 119901 = CMW 10189 CBS 122892 = CPC 12421 ^{ET} CBS 122893 = CPC 14898 CPC 12249 CBS 113059 = CPC 4313 CBS 120035 = CPC 12730 ^{ET} CBS 111577 = CPC 1838 ^{ET} CBS 110696 = CPC 1518 = CPC 18701	<i>Eucalyptus globulus</i> <i>Protea repens</i> <i>Eucalyptus</i> sp. <i>Eucalyptus globulus</i> <i>Eucalyptus globulus</i> <i>Protea repens</i> <i>Eucalyptus globulus</i> <i>Eucalyptus</i> sp. <i>Protea repens</i> <i>Leucadendron laureolum</i> <i>Protea cynaroides</i>	Australia: Western Australia South Africa South Africa Ethiopia Australia: Victoria South Africa Portugal Chile South Africa South Africa South Africa	A. Maxwell P.W. Crous P.W. Crous A. Gezahngne I. Smith L. Mostert A.J.L. Phillips P.W. Crous P.W. Crous & A. Smith L. Swart L. Swart	KF901831 KF902087 KF902025 KF901986 KF901832 KF902088 KF902104 KF901813 KF937220 KF937221 KF901833	– – – – – – – – – – – –	– – – – – – – – – – – –	– – – – – – – – – – – –	– – – – – – – – – – – –	– – – – – – – – – – – –	– – – – – – – – – – – –	
<i>B. sedgelifieldii</i>	CBS 112119 = CPC 3026 ^{ET}	<i>Protea repens</i>	South Africa	J.E. Taylor	KF937222	–	–	–	KF937254	–	–	–
<i>Camarsporula perooniae</i>	CBS 112494 = CPC 3350	<i>Peroonia</i> sp.	Australia	P.W. Crous & B.A. Summerell	JF770460	–	–	–	KF937255	–	–	–
<i>Capnodium coffeae</i>	CBS 147.52	<i>Coffea robusta</i>	Zaire	–	KF902173	–	–	–	KF902196	–	–	–
<i>Catenulostroma hermannusense</i>	CBS 128768 = CPC 18276 ^{ET}	<i>Phaenocoma prolifera</i>	South Africa	K.L. Crous & P.W. Crous	KF902089	–	–	–	KF902197	–	–	–
<i>Cat. protearum</i>	CBS 125421 = CPC 15370 ^{ET}	<i>Leucadendron tinctorum</i>	South Africa	F. Roets	KF902090	–	–	–	KF902198	–	–	–
<i>Cercospora ariminensis</i>	CBS 137.56	<i>Hedysarum coronarium</i>	Italy	M. Ribaldi	KF902004	–	–	–	KF902199	–	–	–
<i>C. beticola</i>	CBS 124.31 = CPC 5070	<i>Beta vulgaris</i>	Romania	E.W. Schmidt	KF902046	–	–	–	KF902200	–	–	–
<i>C. capsici</i>	CBS 118712	–	Fiji	P. Tyler	KF251800	–	–	–	KF252302	–	–	–
<i>C. zebrina</i>	CBS 118790	<i>Trifolium subterraneum</i>	Australia	M.J. Barbetti	KF251651	–	–	–	KF252305	–	–	–
<i>Cladosporium allacinum</i>	CBS 118854	soil of <i>Perilla</i> field	South Korea	S.B. Hong	KJ564335	–	–	–	–	–	–	–
<i>Cl. chialastoporoides</i>	CBS 125985 = CPC 13864 ^{ET}	<i>Protea arborea</i>	South Africa	P.W. Crous	KJ564332	–	–	–	–	–	–	–
<i>Cl. fusiforme</i>	CBS 119414 ^{ET}	hypersaline water of Secovlje saltens	Slovenia	L. Butnar	KJ564333	–	–	–	–	–	–	–
<i>Cl. herbarum</i>	CBS 121621 = CPC 12177 ^{ET}	<i>Hordeum vulgare</i>	The Netherlands	P.W. Crous	KJ564331	–	–	–	–	–	–	–
<i>Cl. hiliianum</i>	CBS 125988 = CPC 15458 ^{ET}	<i>Typha orientalis</i>	New Zealand	R. Beaver	KJ564334	–	–	–	–	–	–	–
<i>Cl. iridis</i>	CBS 138.40 = CPC 15458 ^{ET}	<i>Iris</i> sp.	The Netherlands	Boterenbrood	EU167591	–	–	–	–	–	–	–
<i>Constantinomyces macerans</i>	TRN440	Rock sample	Spain	–	KF310005	–	–	–	KF310068	–	–	–
<i>Con. nebulosus</i>	CBS 117941 = TRN262	Rock sample	Spain	–	KF310014	–	–	–	–	–	–	–
<i>Cystocoleus ebeneus</i>	L348	Rock sample	Austria	Hafelner & Muggia	EU048580	–	–	–	–	–	–	–
<i>Devriesia acadensis</i>	CBS 115874 = DAOM 232211	Heat-treated soil	Canada	N. Nickerson	EU040226	–	–	–	KF937251	–	–	–
<i>D. agapanthi</i>	CBS 132689 = CPC 19833 ^{ET}	<i>Agapanthus africanus</i>	South Africa	P.W. Crous	JX069859	–	–	–	KJ564346	–	–	–
<i>D. americana</i>	CBS 117726 ^{ET}	Air sample	USA	F.M. Dugan	EU040227	–	–	–	–	–	–	–

Table 1 (cont.)

Species	Isolate no. ^{1,2}	Host	Location	Collector	GenBank accession no. ³							
					LSU	Act	Cal	ITS	RPB2	EF-1 α	Btub	
<i>D. bulbilloseae</i>	CBS 118285 = TRN81	Rock sample	Spain: Mallorca	C. Ruibal	KF310029	–	–	–	–	KF310102	–	–
<i>D. capensis</i>	CBS 130602 = CPC 18299 ^{ET} CPC 13981	<i>Protea</i> sp. <i>Protea repens</i>	South Africa Portugal	P.W. Crous M.F. Moura	JN712569 EU707887	–	–	–	–	–	–	–
<i>D. compacta</i>	CBS 118294 = TRN111 ^{ET}	Rock sample	Spain	C. Ruibal	GU323967	–	–	–	–	KF310095	–	–
<i>D. knoxdaviesii</i>	CBS 122898 = CPC 14960 ^{ET} CPC 14905	<i>Protea</i> sp. <i>Protea</i> sp.	South Africa South Africa	P.W. & M. Crous P.W. & M. Crous	EU707865 KJ564328	–	–	–	–	–	–	–
<i>D. lagerstroemiae</i>	CBS 125422 = CPC 14403 ^{ET}	<i>Lagerstroemia indica</i>	USA: Louisiana	P.W. Crous & M.J. Wingfield	KF902149	–	–	–	–	KF902233	–	–
<i>D. modesta</i>	CBS 137182 = CCFEE 5672 ^{ET}	Rock sample	Italy	–	KF310026	–	–	–	–	KF310093	–	–
<i>D. queenslandica</i>	CBS 129527 = CPC 17306 ^{ET}	<i>Scaevola taccada</i>	Australia: Queensland	P.W. Crous, R.G. Shivas & A.R. McTaggart	KF901839	–	–	–	–	KF902234	–	–
<i>D. shakazulii</i>	CBS 133579 = CPC 19784 ^{ET}	Aloe sp.	South Africa	P.W. Crous	KC005797	–	–	–	–	KJ564347	–	–
<i>D. shenburniensis</i>	CBS 115876 = DAOM 232217	Heat-treated soil	Canada	N. Nickerson	EU040228	–	–	–	–	KF937256	–	–
<i>D. simplex</i>	CBS 137183 = CCFEE 5681 ^{ET}	Rock sample	Italy	–	KF310027	–	–	–	–	KF310104	–	–
<i>Devriesia</i> sp.	CPC 11876	<i>Avicermia</i> sp.	South Africa	W. Gams	GQ852622	–	–	–	–	KJ564341	–	–
<i>D. staurophora</i>	CBS 375.81 = ATCC 200934 = CPC 3687	Soil sample	Colombia	H. Valencia	KF901963	–	–	–	–	KF902201	–	–
<i>D. stirlingiae</i>	CBS 117873 = CPC 11198	<i>Amelanchier lamarckii</i>	The Netherlands	G. Verkley	KF937223	–	–	–	–	KF937257	–	–
<i>D. streititziae</i>	CBS 133581 = CPC 19948 ^{ET}	<i>Stirlingia latifolia</i>	Australia	W. Gams	KC005799	–	–	–	–	–	–	–
<i>D. streititzicola</i>	CBS 122379 = X1037 ^{ET}	<i>Streitizia nicolai</i>	South Africa	W. Gams & H. Glen	GU301810	–	–	–	EU436763	GU371738	GU349049	–
<i>D. thermodorans</i>	CBS 115878 = DAOM 225330 ^{ET}	<i>Streitizia</i> sp. Heat-treated soil	Canada	W. Gams & H. Glen N. Nickerson	GU214417 EU040229	–	–	–	–	KF937258	–	–
<i>Dothiroma pini</i>	CBS 115879 = DAOM 226677	Heat-treated soil	Canada	N. Nickerson	KF937224	–	–	–	–	KF937259	–	–
<i>Doth. septosporum</i>	CBS 116483	<i>Pinus nigra</i>	USA	G. Adams	JX901825	–	–	–	–	JX901949	–	–
<i>Elastiomyces elasticus</i>	CBS 383.74 CBS 122538 = CCFEE 5313 ^{ET}	<i>Pinus coulteri</i> Lichen thallus (<i>Usnea antarctica</i>)	France Antarctica	M. Morelet L. Zucconi	KF251807 KJ380894	–	–	–	–	KF252308	–	–
	CCFEE 5474	Rock sample	Antarctica	–	KF309991	–	–	–	–	KF310046	–	–
	CCFEE 5490	Rock sample	Antarctica	–	KF309992	–	–	–	–	KF310047	–	–
	CCFEE 5505	Rock sample	Argentina	–	KF309996	–	–	–	–	–	–	–
	CCFEE 5506	Rock sample	Argentina	–	KF309997	–	–	–	–	KF310048	–	–
	CCFEE 5525	Rock sample	Antarctica	–	KF309998	–	–	–	–	KF310049	–	–
	CCFEE 5526	Rock sample	Antarctica	–	KF309999	–	–	–	–	KF310050	–	–
	CCFEE 5543	Rock sample	India	–	KF309993	–	–	–	–	KF310051	–	–
	CCFEE 5547	Rock sample	Antarctica	–	KF310012	–	–	–	–	KF310052	–	–
<i>Eupendiella venezuelensis</i>	CBS 106.75 ^{ET}	Man, <i>Tinea nigra</i>	Venezuela	D. Borelli	KF902163	–	–	–	–	KF902202	KF903100	KF902803
<i>Euteratosphaeria verrucosiafricana</i>	CBS 118496 = CPC 11167 ^{ET}	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	–	–	–	–	DQ303056	–	–	–
	CBS 118497 = CPC 11169	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	KF901992	–	–	–	–	KF902204	KF903102	KF902804
<i>Extremus adstrictus</i>	CBS 118498 = CPC 11170	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	KF901993	–	–	–	–	KF902542	KF903103	KF902805
<i>Ex. antarcticus</i>	CBS 118292 = TRN96 ^{ET} CCFEE 5312	Rock sample	Spain	C. Ruibal	KF310022	–	–	–	–	KF310103	–	–
	CBS 136103 = CCFEE 451 ^{ET}	Rock sample	Antarctica	–	KF310020	–	–	–	–	KF310086	–	–
	CBS 136104 = CCFEE 5207	Rock sample	Antarctica	–	GU250360	–	–	–	–	KF310085	–	–
	CCFEE 5551	–	Antarctica	–	KF310021	–	–	–	–	KF310087	–	–
<i>Extremus</i> sp.	CBS 118300 = TRN137	Rock sample	Spain	C. Ruibal	KC315879	–	–	–	–	KF310098	–	–
<i>Extremus</i> sp.	CBS 119436 = CCFEE 5177	Rock sample	Antarctica	S. Onofri	GU323973	–	–	–	–	–	–	–
<i>Friedmanniomyces endolithicus</i>	CCFEE 5199	Rock sample	Antarctica	–	KJ564326	–	–	–	–	KF310093	–	–
	CCFEE 5283	Rock sample	Antarctica	–	KF310007	–	–	–	–	KF310053	–	–
	CCFEE 5328	Rock sample	Antarctica	–	KF310006	–	–	–	–	KF310055	–	–
<i>Hortaea thailandica</i>	CBS 125423 = CPC 16651 ^{ET}	<i>Syzygium siamense</i>	Thailand	P.W. Crous & K.D. Hyde	KF902125	–	–	–	–	KF902206	–	–
<i>Lapidomyces hispanicus</i>	CBS 118764 = TRN126	Rock sample	Spain	–	KF310016	–	–	–	–	KF310076	–	–
<i>Lecanosticta brevispora</i>	CBS 133601 = CPC 18092 ^{ET}	<i>Pinus</i> sp.	Mexico	M. de Jesús Yáñez-Morales	KF902021	–	–	–	–	KF902207	–	–
	CPC 18092	<i>Pinus</i> sp.	Mexico	M. de Jesús Yáñez-Morales	JX901855	–	–	–	–	JX901979	–	–

<i>L. longispora</i>	CBS 133602 = CPC 17940 ^{ET}	<i>Pinus</i> sp.	Mexico	M. de Jesús Yáñez-Morales & C. Méndez-Inocencio	KF902022	—	—	—	KF902208	—
	CPC 17940	<i>Pinus</i> sp.	Mexico	M. de Jesús Yáñez-Morales & C. Méndez-Inocencio	JX901857	—	—	—	JX901981	—
	CPC 17941	<i>Pinus</i> sp.	Mexico	M. de Jesús Yáñez-Morales & C. Méndez-Inocencio	JX901858	—	—	—	JX901982	—
<i>Melanodothis caricis</i>	CBS 860.72 ^{ET}	—	—	—	GU214431	—	—	—	—	—
<i>Meristemomyces frigidum</i>	COFEE 5457	Rock sample	Italy	—	GU250389	—	—	—	KF310063	—
	COFEE 5507	Rock sample	Argentina	—	KF310013	—	—	—	KF310066	—
	COFEE 5508	Rock sample	Argentina	—	GU250401	—	—	—	KF310067	—
<i>Microxyphium citri</i>	CBS 451.66	<i>Citrus sinensis</i>	Spain	H.A. van der Aa	KF902094	—	—	—	KF902209	—
<i>Monicola elongata</i>	COFEE 5394	Rock sample	Italy	—	KF309995	—	—	—	KF310062	—
	COFEE 5492	Rock sample	Italy	—	KF309994	—	—	—	—	—
	COFEE 5499	Rock sample	Italy	—	GU250398	—	—	—	KF310065	—
<i>Mucomycesphaerella euryptamii</i>	JK 5586J	<i>Juncus roemerianus</i>	USA: North Carolina	B. & J. Kohlmeier	GU301852	—	—	—	GU371722	—
<i>Mycosphaerella irregulari</i>	CBS 123242 = CPC 15408 = TH1003 ^{ET}	<i>Eucalyptus globulus</i>	Thailand	R. Cheewangkoon	KF902126	KF903542	KF902543	KF901769	KF902213	KF903107
	MAFF 410632	<i>Larix leptolepis</i>	Japan	T. Yokota	JX901863	—	—	—	JX901987	—
	MAFF 410081	<i>Larix leptolepis</i>	Japan	K. Ito	JX901862	—	—	—	JX901986	—
<i>My. madeirae</i>	CBS 112301 = CPC 3747 ^{ET}	<i>Eucalyptus globulus</i>	Portugal: Madeira	S. Denman	KF902033	KF903453	KF902544	KF901688	—	KF903108
	CBS 112895 = CPC 3745 = CMW 14458 ^{ET}	<i>Eucalyptus globulus</i>	Portugal: Madeira	S. Denman	KF902017	—	KF902545	KF901675	KF902214	KF903109
	CBS 130522 ^{ET}	<i>Corymbia intermedia</i>	Australia	A. J. Carnegie	KF901835	—	—	—	KF902216	—
<i>My. nootherensis</i>	CBS 123241 = CPC 15410 = TH126 ^{ET}	<i>Eucalyptus</i> sp.	Thailand	R. Cheewangkoon	KF902127	KF903541	KF902547	KF901770	KF902217	KF903111
<i>My. pseudovespa</i>	CBS 121159 = DAR 77432 ^{ET}	<i>Eucalyptus biturbinata</i>	Australia	A. J. Carnegie	KF901836	KF903535	KF902548	—	KF902218	KF903112
<i>My. quasiparkii</i>	CBS 123243 = CPC 15409 ^{ET}	<i>Eucalyptus</i> sp.	Thailand	P. Suwamawong	KF902128	KF903543	KF902549	KF901771	KF902219	KF903113
<i>My. sumatrensis</i>	CBS 118499 = CPC 11171 ^{ET}	<i>Eucalyptus</i> sp.	Indonesia	M. J. Wingfield	KF901994	KF903498	KF902550	KF901655	KF902220	KF902814
	CBS 118501 = CPC 11175	<i>Eucalyptus</i> sp.	Indonesia	M. J. Wingfield	KF901995	KF903499	KF902551	KF901656	KF902221	KF902815
	CBS 118502 = CPC 11178	<i>Eucalyptus</i> sp.	Indonesia	M. J. Wingfield	KF901996	KF903500	KF902552	KF901657	KF902222	KF902816
<i>My. vietnamensis</i>	CBS 119974 = CMW 23441 = MUCC 66 ^{ET}	<i>Eucalyptus grandis</i> hybrid	Vietnam	T. I. Burgess	KF902171	KF903514	KF902553	KF901809	—	KF903114
<i>Myrtapendiella corymbia</i>	CBS 124769 = CPC 14640 ^{ET}	<i>Corymbia toelscheana</i>	Australia: Northern Territory	B. A. Summerell	KF901838	KF903558	KF902558	KF901517	KF902227	KF902822
	CPC 14641	<i>Corymbia toelscheana</i>	Australia: Northern Territory	B. A. Summerell	KF937225	—	—	—	KF937261	—
	CBS 123245 = CPC 15449	<i>Eucalyptus camaldulensis</i>	Thailand	R. Cheewangkoon	KF902129	—	—	—	KF902228	—
<i>Myr. eucalypti</i>	CBS 123246 = CPC 15411 ^{ET}	<i>Eucalyptus camaldulensis</i>	Thailand	P. Suwamawong	KF902130	KF903545	KF902559	KF901772	KF902229	KF903120
	CBS 124993 = CPC 13692 ^{ET}	<i>Eucalyptus tenuiramis</i>	Australia: Tasmania	B. A. & P. Summerell	GQ852626	—	—	—	KF937262	—
<i>Myr. tenuiramis</i>	CPC 13692	<i>Eucalyptus tenuiramis</i>	Australia: Tasmania	B. A. & P. Summerell	KF901997	KF903658	KF902560	KF901658	KF902230	KF903121
<i>Neocateulostroma abietis</i>	CBS 110038	Painted outdoor wall	Sweden	N. Hellenberg	KF937226	—	—	—	KF937263	—
<i>Neoc. germanicum</i>	CBS 539.88 ^{ET}	Rock sample	Germany	J. Kuroczkin	KF901989	—	—	—	KF902231	—
<i>Neoc. microsporium</i>	CBS 101951 = CPC 1960 ^{ET} of sexual morph	<i>Protea cynaroides</i>	South Africa	J. E. Taylor & S. Denman	KF901814	—	KF902561	KF901499	KF902232	KF903122
	CBS 10890 = CPC 1832 ^{ET} of sexual morph	<i>Protea cynaroides</i>	South Africa	J. E. Taylor & S. Denman	EU019255	JX500130	—	AY260097	—	—
<i>Neodevriesia hiliiana</i>	CBS 111031 = CPC 1848	<i>Protea cynaroides</i>	South Africa	J. E. Taylor & S. Denman	KF937227	—	—	—	KF937264	—
<i>Neodevriesia xanthorrhoeae</i>	CBS 123187 = CPC 15382 ^{ET}	<i>Macrozamia communis</i>	New Zealand	C. F. Hill	GU214414	—	—	—	—	—
	CBS 128219 = CPC 17720 ^{ET}	<i>Xanthorrhoea australis</i>	Australia	P. W. Crous, I. Pascoe & J. Edwards	HQ599606	—	—	—	—	—
<i>Neodevriesia</i> sp.	CBS 118302 = TRN142	Rock sample	Spain: Mallorca	C. Ruibal	GU323975	—	—	—	KF310100	—
<i>Neodevriesiaceae</i> sp.	CPC 19594	mycoparasite of <i>Myriangium</i> sp.	Brazil	K. J. Evans	KJ564327	—	—	—	KJ564349	—
<i>Neohortaea acidophila</i>	CBS 113389 ^{ET}	Lignite rock	Germany	U. Holker	GU323202	—	—	—	GU214636	—
<i>Neopendiella nectandrae</i>	CBS 734.87 ^{ET}	<i>Nectandra coriacea</i>	Cuba	R. F. Castañeda & G. Arnold	KF901982	—	—	—	KF902235	—
<i>Neophaeothecoidea proteae</i>	CBS 114129 = CPC 2831 ^{ET}	<i>Protea repens</i>	South Africa	S. Denman	KF937228	—	—	—	KF937265	—
<i>Neotrimmatostroma excentricum</i>	CBS 121102 = CPC 13092 ^{ET}	<i>Eucalyptus agglomerata</i>	Australia: New South Wales	G. Price	KF901840	KF903534	KF902562	KF901518	KF902236	KF903123
<i>Oleoguttula mirabilis</i>	COFEE 5522	Rock sample	Antarctica	—	KF310019	—	—	—	KF310070	—
<i>Pallidocerospora acaciigena</i>	CBS 112515 = CPC 3837 ^{ET}	<i>Acacia mangium</i>	Venezuela	M. J. Wingfield	KF902166	KF903455	KF902564	KF901805	KF902238	KF903125
	CBS 112516 = CPC 3838 ^{ET}	<i>Acacia mangium</i>	Venezuela	M. J. Wingfield	KF902105	KF903456	KF902563	KF901751	KF902237	KF903124
	CBS 115432 = CPC 3836 ^{ET}	<i>Acacia mangium</i>	Venezuela	M. J. Wingfield	KF902165	—	—	—	KF902211	KF903105

Table 1 (cont.)

Species	Isolate no. ^{1,2}	Host	Location	Collector	GenBank accession no. ³						
					LSU	Act	Cal	ITS	RPB2	EF-1 α	Btub
<i>P. colombiensi</i>	CBS 120740 = CPC 13290	<i>Eucalyptus</i> sp.	Australia	B.A. Summerell	KF901834	–	–	KF901515	KF902212	KF903106	KF902808
	CPC 13350	<i>Eucalyptus camaldulensis</i> × <i>Eucalyptus urophylla</i>	Venezuela	M.J. Wingfield	KF902164	–	–	KF901803	KF902210	KF903104	KF902806
	CBS 110967 = CPC 1104 = CMW 11255 ^{ET}	<i>Eucalyptus urophylla</i>	Colombia	M.J. Wingfield	KF901988	KF903413	KF902611	KF901633	KF902295	KF903178	KF902880
	CBS 110968 = CPC 1105 ^{ET}	<i>Eucalyptus urophylla</i>	Colombia	M.J. Wingfield	KF901969	KF903414	KF902612	KF901634	KF902296	KF903179	KF902881
	CBS 110969 = CPC 1106 = CMW 4944 ^{ET}	<i>Eucalyptus urophylla</i>	Colombia	M.J. Wingfield	KF901970	KF903415	KF902613	KF901635	KF902297	KF903180	KF902882
<i>P. crystallina</i>	CBS 110699 = CPC 2155	<i>Leucospermum</i> sp.	USA: Hawaii	P.W. Crous & M.E. Palm	KF902161	KF903400	KF902566	KF901801	KF902240	KF903127	KF902830
	CBS 111044 = CPC 1178	Leaf litter of <i>Eucalyptus grandis</i> × <i>Eucalyptus camaldulensis</i>	South Africa	M.J. Wingfield	KF902050	KF903423	KF902567	KF901703	KF902241	KF903128	KF902831
<i>P. heimii</i>	CBS 111045 = CPC 1179	<i>Eucalyptus camaldulensis</i>	South Africa	M.J. Wingfield	KF902051	KF903424	KF902568	KF901704	KF902242	KF903129	KF902832
	CBS 681.95 = CPC 802 = CMW 3033 ^{ET}	<i>Eucalyptus bicostata</i>	South Africa	M.J. Wingfield	KF902052	KF903590	KF902569	KF901705	KF902243	KF903130	KF902833
	CPC 11453	<i>Eucalyptus</i> sp.	Brazil	A.C. Alfenas	KF901934	KF903601	KF902565	KF901609	KF902239	KF903126	KF902829
	CBS 110682 = CPC 760 = CMW 4942 ^{ET}	<i>Eucalyptus</i> sp.	Madagascar	P.W. Crous	KF902013	KF903399	KF902575	KF901671	KF902249	KF903136	KF902839
	CPC 10992	<i>Eucalyptus</i> sp.	Colombia	M.J. Wingfield	KF901964	KF903593	KF902570	KF901629	KF902244	KF903131	KF902834
<i>P. heimoides</i>	CPC 11441	<i>Eucalyptus</i> sp.	Brazil	A.C. Alfenas	KF901935	KF903600	KF902571	KF901610	KF902245	KF903132	KF902835
	CPC 11548	<i>Eucalyptus</i> sp.	Brazil	A.C. Alfenas	KF901936	KF903602	KF902572	KF901611	KF902246	KF903133	KF902836
	CPC 11716	–	Brazil	A.C. Alfenas	KF901937	KF903605	KF902573	KF901612	KF902247	KF903134	KF902837
	CPC 11926	<i>Acacia auriculiformis</i>	Thailand	W. Himaman	KF902131	KF903607	KF902581	KF901773	KF902257	KF903144	KF902847
	CPC 13099	<i>Eucalyptus dunii</i>	Australia	A.J. Carnegie	KF901841	KF903635	KF902574	KF901519	KF902248	KF903135	KF902838
	CBS 111190 = CPC 1312 = CMW 3046 ^{ET}	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	KF901998	KF903440	KF902576	KF901659	KF902250	KF903137	KF902840
	CBS 111364 = CPC 1311 = CMW 14776	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	KF901815	KF903446	KF902577	KF901500	KF902251	KF903138	KF902841
	CBS 110698 = CPC 2126 ^{ET}	<i>Leucospermum</i> sp.	USA: Hawaii	P.W. Crous & M.E. Palm	KJ380896	–	–	AY260087	KJ380900	–	–
	CBS 111211 = CPC 1362 = CMW 5223 ^{ET}	<i>Eucalyptus saligna</i>	South Africa	M.J. Wingfield	KF902053	KF903441	KF902578	KF901706	KF902252	KF903139	KF902842
	<i>P. konae</i>	CBS 111028 = CPC 2125 ^{ET}	<i>Leucaedron</i> cv. 'Safari Sunset'	USA: Hawaii	P.W. Crous & M.E. Palm	KF902158	KF903422	–	KF901798	KF902253	KF903140
CBS 111261 = CPC 2123 ^{ET}		<i>Leucaedron</i> cv. 'Safari Sunset'	USA: Hawaii	P.W. Crous & M.E. Palm	KF902159	KF903442	–	KF901799	KF902254	KF903141	KF902844
CBS 116367 = CPC 10547 ^{ET}		<i>Acacia mangium</i>	Thailand	K. Pongpanich	KF902134	–	–	KF901776	KF902337	KF903221	KF902923
CBS 120723 = CPC 13478		<i>Eucalyptus camaldulensis</i>	Thailand	W. Himaman	KF902135	KF903524	KF902648	KF901777	KF902338	KF903222	KF902924
CBS 121389 = X882 = CIRAD 81		<i>Musa</i> sp.	Brazil	–	KF902023	–	–	KF901679	KF902339	KF903223	KF902925
<i>Paramyosphaerella intermedia</i>	CBS 121390 = X883 = CIRAD 1165	<i>Musa</i> sp.	Cameroon	–	KF901956	–	–	KF901624	KF902340	KF903224	KF902926
	CBS 114356 = CPC 10902 = NZFS 301 K/1	<i>Eucalyptus saligna</i>	New Zealand	L. Renney	KF902026	KF903466	KF902579	KF901681	KF902255	KF903142	KF902845
	CBS 114415 = CPC 10922 = NZFS 301.13	<i>Eucalyptus saligna</i>	New Zealand	L. Renney	KF902027	KF903468	KF902580	KF901682	KF902256	KF903143	KF902846
	CBS 110693 = CPC 823	<i>Eucalyptus grandis</i> × <i>saligna</i>	South Africa	G. Kemp	DQ204758	–	–	DQ267597	–	–	–
	CBS 110750 = CPC 822 = CMW 14778	<i>Eucalyptus grandis</i> × <i>saligna</i>	South Africa	G. Kemp	KF902056	KF903404	KF902586	KF901709	KF902262	KF903149	KF902852
<i>Parapendideiella pseudo-tasmaniensis</i>	CBS 110920 = CPC 935	<i>Eucalyptus globulus</i>	Australia: Victoria	A.J. Carnegie	KF901842	KF903410	KF902582	KF901520	KF902258	KF903145	KF902848
	CBS 110963 = CPC 4632	<i>Musa</i> sp.	South Africa	K. Surridge	KF902054	KF903411	KF902583	KF901707	KF902259	KF903146	KF902849
	CBS 110964 = CPC 4633	<i>Musa</i> sp.	South Africa	K. Surridge	KF902055	KF903412	KF902584	KF901708	KF902260	KF903147	KF902850
	CBS 110981 = CPC 1073	<i>Eucalyptus</i> sp.	Tanzania	M.J. Wingfield	KF902103	KF903417	KF902585	KF901749	KF902261	KF903148	KF902851
	CBS 124991 = CPC 12400 ^{ET}	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901844	KF903562	KF902589	KF901522	KF902265	KF903152	KF902855
<i>Para. tasmaniensis</i>	CBS 111687 = CMW 14780 = CPC 1555 ^{ET}	<i>Eucalyptus nitens</i>	Australia: Tasmania	M.J. Wingfield	KF901843	KF903451	KF902587	KF901521	KF902263	KF903150	KF902853

<i>Parateratosphaeria altensteinii</i>	CBS 114556 = CMW 14663 = CPC 15133 ^{ET}	Eucalyptus nitens	Australia: Tasmania	M.J. Wingfield	KF902132	KF903469	KF902588	KF901774	KF902264	KF903151	KF902854
<i>Pata. bellula</i>	CBS 111700 = CPC 1821 ^{ET}	<i>Encephalartos altensteinii</i>	South Africa	P.W. Crous, M.K. Crous, M. Crous & K. Raath	KF937230	–	–	–	KF937267	–	–
<i>Pata. karinae</i>	CBS 128774 = CPC 18255 ^{ET}	<i>Protea eximia</i>	South Africa	J.E. Taylor	KF937232	–	–	–	–	–	–
<i>Pata.cf. bellula</i>	CBS 111699 = CPC 1816	<i>Phaenocoma prolifera</i>	South Africa	K.L. Crous & P.W. Crous	KF902091	–	–	–	KF902266	–	–
<i>Pata. marasasi</i>	CBS 122899 = CPC 14889 ^{ET}	<i>Leucospermum</i> sp.	South Africa	J.E. Taylor	KF937231	–	–	–	–	–	–
<i>Pata. persoonii</i>	CBS 122895 = CPC 13972 ^{ET}	<i>Protea</i> sp.	South Africa	P.W. & M. Crous	KF937233	–	–	–	KF937268	–	–
	CBS 122896 = CPC 14846 = STE-U 6389	<i>Eucaetis meridionalis</i>	South Africa	P.W. Crous & L. Mostert	KF937234	–	–	–	–	–	–
<i>Passalora eucalypti</i>	CBS 111318 = CPC 1457 ^{ET}	<i>Eucalyptus saligna</i>	Brazil	P.W. Crous & A.C. Alfenas	KF901938	KF903445	KF902590	KF901613	KF902267	KF903153	KF902856
<i>Pas. intermedia</i>	CBS 124154 = CPC 15745 = A39 ^{ET}	<i>Eucalyptus camaldulensis</i>	Madagascar	M.J. Wingfield	KF902014	KF903548	KF902591	KF901672	KF902268	KF903154	KF902857
<i>Pas. leptophlebiae</i>	CBS 129524 = CPC 18480 ^{ET}	<i>Eucalyptus leptophlebia</i>	Brazil	P.W. Crous, A.C. Alfenas, R. Alfenas & O.L. Pereira	KF901939	KF903580	–	KF901614	KF902269	KF903155	KF902858
<i>Pas. zambiae</i>	CBS 112970 = CPC 1228 ^{ET}	<i>Eucalyptus globulus</i>	Zambia	T. Coutinho	KF902175	KF903458	KF902593	KF901811	KF902271	KF903157	–
<i>Penicillia columbiana</i>	CBS 112971 = CPC 1227 ^{ET}	<i>Eucalyptus globulus</i>	Zambia	T. Coutinho	KF902174	KF903459	KF902592	KF901810	KF902270	KF903156	KF902859
<i>Petrophila incerta</i>	CBS 486.80 ^{ET}	<i>Paepalanthus columbianus</i>	Colombia	W. Gams	KF901965	KF903587	KF902594	KF901630	KF902272	KF903158	KF902860
	CBS 118287 = TRN77	Rock sample	Spain	C. Ruibal	GU323963	–	–	–	KF310101	–	–
	CBS 118608 = TRN139b ^{ET}	Rock sample	Spain	C. Ruibal	KF310030	–	–	–	KF310091	–	–
<i>Phaeophleospora eugeniae</i>	CPC 15143	<i>Eugenia uniflora</i>	Brazil	A.C. Alfenas	KF901940	KF903674	KF902596	KF901615	KF902274	KF903160	KF902862
<i>Pha. eugenicola</i>	CPC 15159	<i>Eugenia uniflora</i>	Brazil	A.C. Alfenas	KF902095	KF903675	KF902595	KF901742	KF902273	KF903159	KF902861
<i>Pha. gregaria</i>	CPC 2557 ^{ET}	<i>Eugenia klotzschiana</i>	Brazil	A.C. Alfenas	KF901845	–	–	KF901523	KF902275	–	–
	CBS 110501	<i>Eucalyptus globulus</i>	Australia	A. Maxwell	KF901846	KF903396	KF902597	KF901524	KF902276	KF903161	KF902863
	CBS 111166 = CPC 1224	<i>Eucalyptus cladocalyx</i>	South Africa	A.R. Wood	KF902057	KF903433	KF902598	KF901710	KF902277	KF903162	KF902864
	CBS 111167 = CPC 1225	<i>Eucalyptus cladocalyx</i>	South Africa	A.R. Wood	KF902058	KF903434	KF902599	KF901711	KF902278	KF903163	KF902865
	CBS 111519 = CPC 1191	<i>Eucalyptus</i> sp.	South Africa	P.W. Crous	KF902059	KF903448	KF902600	KF901712	KF902279	KF903164	KF902866
	CBS 114662 = CPC 1193 ^{ET} ^{ET/ M. androphylla}	<i>Eucalyptus</i> sp.	South Africa	P.W. Crous	KF902060	KF903470	KF902601	KF901713	KF902280	KF903165	KF902867
	CBS 118493 = CPC 10998 ^{ET}	<i>Eucalyptus urophylla</i>	Colombia	M.J. Wingfield	KF901966	KF903493	KF902603	KF901631	KF902282	KF903167	KF902869
	CBS 516.93 = CPC 653	<i>Eucalyptus globulus</i>	Brazil	F.A. Ferreira	KF901941	KF903588	KF902602	KF901616	KF902281	KF903166	KF902868
	CBS 120830 = CPC 1330 ^{ET}	<i>Eucalyptus</i> sp.	Australia	P.W. Crous & J. Stone	KF901847	KF903645	KF902604	KF901525	KF902283	KF903168	KF902870
<i>Pha. stramentii</i>	CBS 118909 = CPC 11545 ^{ET}	Leaf litter of <i>Eucalyptus</i> sp.	Brazil	A.C. Alfenas	KF901942	KF903506	KF902605	KF901617	KF902284	KF903169	KF902871
<i>Phaeothecoidea eucalypti</i>	CBS 120831 = CPC 12918 ^{ET}	<i>Eucalyptus botryoides</i>	Australia: New South Wales	B.A. Summerell	KF901848	–	–	KF901526	KF902285	KF903170	KF902872
<i>Phaeo. intermedia</i>	CBS 124994 = CPC 13711 ^{ET}	<i>Eucalyptus globulus</i>	Australia: Bruny Island	B.A. Summerell, P. Summerell & A. Summerell	KF902106	KF903564	KF902606	KF901752	KF902286	KF903171	KF902873
	CPC 13711	<i>Eucalyptus globulus</i>	Australia: Bruny Island	P. Summerell, B.A. Summerell, B.A. Summerell,	GQ852628	–	–	–	KF937269	–	–
<i>Phaeo. minutispora</i>	CBS 124995 = CPC 13710 ^{ET}	<i>Eucalyptus globulus</i>	Australia: Bruny Island	P. Summerell, B.A. Summerell,	KF902107	–	–	–	KF902287	–	–
	CPC 13710	<i>Eucalyptus globulus</i>	Australia: Bruny Island	P. Summerell & A. Summerell	KF902108	KF903659	KF902607	KF901753	KF902288	KF903172	KF902874
<i>Piedraia hortae</i> var. <i>hortae</i>	CBS 480.64	Human hair	Brazil	KF901943	–	–	–	–	KF902289	–	–
<i>Piedraia hortae</i> var. <i>paraguayensis</i>	CBS 276.32	–	–	KF901816	–	–	–	–	–	–	–
<i>Ple. quintanilhae</i>	CBS 327.63 ^{ET}	<i>Genetta tigrina</i>	Central African Republic	N. van Uden	KF901957	–	–	–	–	–	–
<i>Polychaeton citri</i>	CBS 116435	<i>Citrus aurantium</i>	Iran	R. Zare & W. Gams	GU214469	–	–	–	–	–	–
<i>Polyphloeosporia tabebuiae-serratifoliae</i>	CBS 112650 = CPC 3944 ^{ET}	<i>Tabebuia serratifolia</i>	Brazil	A.C. Alfenas	KF251716	–	–	–	KF252218	–	–
<i>Pseudocercospora basiramifera</i>	CBS 111072 = CPC 1266 ^{ET}	<i>Eucalyptus pellita</i>	Thailand	M.J. Wingfield	KF902028	KF903428	KF902608	KF901683	KF902291	KF903174	KF902876
<i>Ps. basitruncata</i>	CBS 114757 = CPC 1267 ^{ET}	<i>Eucalyptus pellita</i>	Thailand	M.J. Wingfield	KF901817	KF903472	KF902609	KF901501	KF902292	KF903175	KF902877
	CBS 114664 = CPC 1202 = CMW 14914	<i>Eucalyptus grandis</i>	Colombia	M.J. Wingfield	KF901967	KF903471	KF902610	KF901632	KF902293	KF903176	KF902878
<i>Ps. chiangmaiensis</i>	CBS 123244 = CPC 15412 ^{ET}	<i>Eucalyptus camaldulensis</i>	Thailand	P. Suwannawong	KF902133	KF903544	–	KF901775	KF902294	KF903177	KF902879
<i>Ps. crousil</i>	CBS 119487 = Lynfield 1260	<i>Eucalyptus</i> sp.	New Zealand	C.F. Hill	KF902029	KF903511	KF902614	KF901684	KF902298	KF903181	KF902883
<i>Ps. eucalyptorum</i>	CBS 110722 = CPC 15	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF902061	KF903401	KF902618	KF901714	KF902302	KF903185	KF902887
	CBS 110723 = CPC 17	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF902062	KF903402	KF902619	KF901715	KF902303	KF903186	KF902888
	CBS 110776 = CPC 12	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF902063	KF903403	KF902620	KF901716	KF902304	KF903187	KF902889
	CBS 110777 = CPC 16 = CMW 5228 ^{ET} ^{ET/ cf. Ps. eucalyptorum}	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF901944	KF903406	KF902621	KF901618	KF902305	KF903188	KF902890

Table 1 (cont.)

Species	GenBank accession no. ³										
	Isolate no. ^{1,2}	Host	Location	Collector	LSU	Act	Cal	ITS	RPB2	EF-1 α	Btub
<i>Ps. schizobolii</i>	CBS 110903 = CPC 14	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF902064	KF903408	KF902622	KF901717	KF902306	KF903189	KF902891
	CBS 111268 = CPC 1195	<i>Eucalyptus grandis</i>	Kenya	T. Coutinho	KF901818	KF903443	KF902623	KF901502	KF902307	KF903190	KF902892
	CBS 114242 = CPC 10390 = CMW 14908 ^{ET} of <i>Ps. pseudoeucalyptorum</i>	<i>Eucalyptus globulus</i>	Spain	J.P. Mansilla	KF902097	–	–	KF901744	KF902328	KF903212	KF902914
	CBS 114866 = CPC 11	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF902067	KF903474	KF902627	KF901720	KF902311	KF903195	KF902897
	CBS 116303 = CPC 13	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF902065	KF903482	KF902625	KF901718	KF902308	KF903192	KF902894
	CBS 116304 = CPC 10	<i>Eucalyptus nitens</i>	South Africa	P.W. Crous	KF902066	KF903483	KF902626	KF901719	KF902309	KF903193	KF902895
	CBS 116359 = CPC 3751	<i>Eucalyptus</i> sp.	Spain: Madeira	–	KF902018	KF903484	–	KF901676	KF902310	KF903194	KF902896
	CBS 132015 = CPC 11713	<i>Eucalyptus globulus</i>	Spain	P. Mansilla	KF902096	KF903604	KF902615	KF901743	KF902299	KF903182	KF902884
	CBS 132029 = CPC 12406	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901849	KF903615	KF902616	KF901527	KF902300	KF903183	KF902885
	CBS 132032 = CPC 12802	<i>Eucalyptus globulus</i>	Portugal	A.J.L. Phillips	KF902034	KF903625	KF902634	KF901689	KF902322	KF903206	KF902908
<i>Ps. flavomarginata</i>	CBS 132033 = CPC 12957	<i>Eucalyptus deanei</i>	Australia	A.J.L. Phillips	KF901850	KF903630	KF902617	KF901528	KF902301	KF903184	KF902886
	CBS 132034 = CPC 13455	<i>Eucalyptus</i> sp.	Portugal	P.W. Crous	KF902035	KF903649	KF902638	KF901690	KJ564342	KF903210	KF902912
	CBS 132035 = CPC 13769	<i>Eucalyptus punctata</i>	South Africa	P.W. Crous	KF902071	KF903660	KF902635	KF901724	KF902323	KF903207	KF902909
	CBS 132105 = CPC 13926	<i>Eucalyptus</i> sp.	USA: California	S. Denman	KF902141	KF903669	KF902636	KF901783	KF902324	KF903208	KF902910
	CBS 132114 = CPC 13816	<i>Eucalyptus glaucescens</i>	United Kingdom	S. Denman	KF902140	KF903661	KF902639	KF901782	KF902327	KF903211	KF902913
	CBS 132309 = CPC 12568	<i>Eucalyptus nitens</i>	Australia: Tasmania	C. Mohammed	KF902109	KF903621	KF902637	KF901754	KF902325	KF903209	KF902911
	CBS 118824 = CMW 13594 ^{ET}	<i>Eucalyptus camaldulensis</i>	Thailand	M.J. Wingfield	KF901961	KF903505	–	KF901627	KF902312	KF903196	KF902898
	CBS 113285 = CMW 9095 ^{ET}	<i>Eucalyptus camaldulensis</i>	South Africa	G.C. Hunter	KF902069	KF903462	KF902629	KF901722	KF902314	KF903198	KF902900
	CBS 113286 = CMW 9095	<i>Eucalyptus</i> sp.	South Africa	J. Roux	KF902068	KF903463	KF902628	KF901721	KF902313	KF903197	KF902899
	CBS 111189 = CPC 1315	<i>Eucalyptus urophylla</i>	Indonesia	M.J. Wingfield	KF902000	KF903439	KF902632	KF901661	KF902317	KF903201	KF902903
<i>Ps. gracilis</i>	CBS 116291 = CPC 10503	<i>Eucalyptus globulus</i>	China	A. Aptroot	KF901960	–	KF902624	–	–	KF903191	KF902893
	CPC 11144	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	KF901971	KF903594	KF902630	KF901636	KF902315	KF903199	KF902901
	CPC 11181	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	KF901999	KF903595	KF902631	KF901660	KF902316	KF903200	KF902902
	CBS 124155 = CPC 14621 ^{ET}	<i>Eucalyptus camaldulensis</i>	Madagascar	M.J. Wingfield	KF902010	KF903549	–	KF901673	KF902318	KF903202	KF902904
	CBS 131582 = CPC 12497 ^{ET}	<i>Fraxinus rhynchophylla</i>	South Korea	H.D. Shin	KF902015	KF903618	KF902641	KF901668	KF902330	KF903214	KF902916
	CBS 111069 = CPC 1263 = CMW 14777 ^{ET}	<i>Eucalyptus nitens</i>	South Africa	T. Coutinho	KF902070	KF903427	–	KF901723	KF902319	KF903203	KF902905
	CBS 120738 = CPC 13049 ^{ET}	<i>Eucalyptus</i> sp.	Italy	W. Gams	KF902005	KF903551	KF902633	KF901665	KF902320	KF903204	KF902906
	CBS 111286 = CPC 1459 = CMW 14779	<i>Eucalyptus nitens</i>	Brazil	P.W. Crous	KF901945	KF903444	–	KF901619	KF902321	KF903205	KF902907
	CBS 131589 = CPC 10808 ^{ET}	<i>Pyracantha argustifolia</i>	South Korea	M.J. Park	KF902009	KF903591	–	KF901667	KF902290	KF903173	KF902875
	CBS 111175 = CPC 1269 = CMW 5151 ^{ET}	<i>Eucalyptus robur</i>	Malaysia	M.J. Wingfield	KF902020	KF903437	KF902640	KF901678	KF902329	KF903213	KF902915
<i>Ps. sphaerulinae</i>	CBS 120029 = CPC 12962 ^{ET}	<i>Schizobolium parahybum</i>	Ecuador	M.J. Wingfield	KF251826	–	–	–	KF252326	–	–
	CBS 112621 = CPC 4314	<i>Eucalyptus</i> sp.	Chile	P.W. Crous	KF901958	–	KF902642	KF901625	KF902331	KF903215	KF902917
	CBS 118489 = CPC 10849	<i>Eucalyptus botryoides</i>	New Zealand	M. Dick	KF902030	KF903492	KF902643	KF901685	KF902332	KF903216	KF902918
	CBS 124996 = CPC 12960	<i>Eucalyptus nitens</i>	Australia	A.J. Carnegie	KF901852	KF903565	KF902645	KF901530	KF902334	KF903218	KF902920
	CBS 125214 = CPC 13299 ^{ET}	<i>Eucalyptus tereticornis</i>	Australia	P.W. Crous & B. Summerell	KF901854	KF903641	KF902647	KF901532	KF902336	KF903220	KF902922
	CPC 13008	<i>Eucalyptus tereticornis</i>	Australia	A.J. Carnegie	KF901853	KF903631	KF902646	KF901531	KF902335	KF903219	KF902921
	CPC 13315	<i>Eucalyptus tereticornis</i>	Australia	P.W. Crous & B. Summerell	KF901851	KF903643	KF902644	KF901529	KF902333	KF903217	KF902919
	CBS 132012 = CPC 11595	<i>Vitis vinifera</i>	South Korea	H.D. Shin	KF902011	KF903603	KF902649	KF901669	KF902341	KF903225	KF902927
	CBS 283.92 ^{ET}	Forrest soil	Brazil	D. Attili	EU041854	–	–	–	–	–	–
	<i>Pseudoramichloridium brasiliense</i>	CBS 124775 = CPC 13121 ^{ET}	<i>Corymbia henryi</i>	Australia	A.J. Carnegie	KF901857	KF903559	KF902652	KF901535	KF902344	KF903227
CPC 13122		<i>Corymbia henryi</i>	Australia	A.J. Carnegie	KF901855	KF903639	KF902650	KF901533	KF902342	KF903226	KF902928
CBS 110743 = CPC 673		<i>Eucalyptus globulus</i>	Colombia	M.J. Wingfield	KF902098	KF903403	KF902653	KF901745	KF902345	KF903228	KF902931
CBS 111012 = CPC 1109 ^{ET}		<i>Eucalyptus globulus</i>	Colombia	M.J. Wingfield	KF902110	KF903421	KF902654	KF901755	KF902346	–	KF902932
CBS 111048 = CPC 1199		<i>Eucalyptus grandis</i>	Colombia	M.J. Wingfield	KF901978	KF903425	KF902723	KF901643	KF902433	KF903309	KF903007
CBS 111163 = CPC 1201		<i>Eucalyptus grandis</i>	Colombia	M.J. Wingfield	KF901979	KF903430	KF902724	KF901644	KF902434	KF903310	KF903008
CBS 118495 = CPC 11138 ^{ET}		<i>Eucalyptus</i> sp.	India	W. Gams & M. Arzanlou	KF901990	KF903494	KF902655	KF901650	KF902347	KF903229	KF902933
CBS 112896 = CPC 1004 ^{ET}		<i>Eucalyptus grandis</i>	South Africa	M.J. Wingfield	KF901946	KF903457	KF902656	KF901620	KF902348	KF903230	KF902934
CBS 112973 = CPC 1005		<i>Eucalyptus grandis</i>	South Africa	M.J. Wingfield	GU214511	–	–	AF173299	–	–	–
<i>Pseudoteratosphaeria flexuosa</i>		CBS 124775 = CPC 13121 ^{ET}	<i>Corymbia henryi</i>	Australia	A.J. Carnegie	KF901857	KF903559	KF902652	KF901535	KF902344	KF903227
	CPC 13122	<i>Corymbia henryi</i>	Australia	A.J. Carnegie	KF901855	KF903639	KF902650	KF901533	KF902342	KF903226	KF902928
	CBS 110743 = CPC 673	<i>Eucalyptus globulus</i>	Colombia	M.J. Wingfield	KF902098	KF903403	KF902653	KF901745	KF902345	KF903228	KF902931
	CBS 111012 = CPC 1109 ^{ET}	<i>Eucalyptus globulus</i>	Colombia	M.J. Wingfield	KF902110	KF903421	KF902654	KF901755	KF902346	–	KF902932
	CBS 111048 = CPC 1199	<i>Eucalyptus grandis</i>	Colombia	M.J. Wingfield	KF901978	KF903425	KF902723	KF901643	KF902433	KF903309	KF903007
	CBS 111163 = CPC 1201	<i>Eucalyptus grandis</i>	Colombia	M.J. Wingfield	KF901979	KF903430	KF902724	KF901644	KF902434	KF903310	KF903008
	CBS 118495 = CPC 11138 ^{ET}	<i>Eucalyptus</i> sp.	India	W. Gams & M. Arzanlou	KF901990	KF903494	KF902655	KF901650	KF902347	KF903229	KF902933
	CBS 112896 = CPC 1004 ^{ET}	<i>Eucalyptus grandis</i>	South Africa	M.J. Wingfield	KF901946	KF903457	KF902656	KF901620	KF902348	KF903230	KF902934
	CBS 112973 = CPC 1005	<i>Eucalyptus grandis</i>	South Africa	M.J. Wingfield	GU214511	–	–	AF173299	–	–	–

Table 1 (cont.)

Species	Isolate no. ^{1,2}	Host	Location	Collector	GenBank accession no. ³							
					LSU	Act	Cal	ITS	RPB2	EF-1 α	Btub	
<i>Sph. myriadea</i>	CBS 124846 = JCM 15565	<i>Quercus dentata</i>	Japan	K. Tanaka	KF251754	–	–	–	–	KF252256	–	–
<i>Steninvardia suttonii</i>	CBS 120061 = CPC 13055 ^{ET}	<i>Eucalyptus robusta</i>	Australia	B.A. Summerell	KF901874	–	KF902693	–	–	KF902392	KF903270	KF902974
<i>Stenella araguata</i>	CBS 105.75 = ATCC 24788 = FMC 245 ^{ET}	Man, <i>linea nigra</i>	Venezuela	D. Borelli	KF902168	–	–	–	–	KF902393	–	–
<i>Suberoteratosphaeria pseudosuberosa</i>	CBS 118911 = CPC 12085 ^{ET}	<i>Eucalyptus</i> sp.	Uruguay	M.J. Wingfield	KF902144	–	–	–	–	–	KF903275	KF902979
<i>Sub. suberosa</i>	CBS 436.92 = CPC 515 ^{ET}	<i>Eucalyptus dunni</i>	Brazil	M.J. Wingfield	KF901949	–	–	–	–	–	–	–
	CPC 13090	<i>Eucalyptus agglomerata</i>	Australia: New South Wales	A.J. Carnegie	KF902117	–	–	–	–	–	–	–
	CPC 13091	<i>Eucalyptus dunni</i>	Australia: New South Wales	A.J. Carnegie	KF901875	–	–	–	–	–	–	–
	CPC 13104	<i>Eucalyptus dunni</i>	Australia: New South Wales	A.J. Carnegie	KF901876	–	–	–	–	–	–	–
	CPC 13106	<i>Eucalyptus argopholia</i>	Australia: New South Wales	A.J. Carnegie	KF901877	–	–	–	–	–	–	–
	CPC 13111	<i>Eucalyptus dunni</i>	Australia: New South Wales	A.J. Carnegie	KF901878	–	–	–	–	–	–	–
	CBS 134747 = CPC 13093 ^{ET}	<i>Eucalyptus molucana</i>	Australia: Queensland	A.J. Carnegie	KF901879	–	–	–	–	–	–	–
<i>Teratosphaeria agapanthi</i>	CBS 129064 = CPC 18332	<i>Agapanthus umbellatus</i>	Portugal	P.W. Crous	KF902036	–	–	–	–	–	–	–
<i>Ter. alboconidia</i>	CBS 125004 = CPC 14598 ^{ET}	<i>Eucalyptus miniata</i>	Australia: Northern Territory	B.A. Summerell	KF901881	–	–	–	–	–	–	–
<i>Ter. alcornii</i>	CBS 121100 = CPC 13384 ^{ET}	<i>Corymbia variegata</i>	Australia: New South Wales	G. Price	KF901882	–	–	–	–	–	–	–
<i>Ter. angophorae</i>	CBS 120493 = DAR 77452 ^{ET}	<i>Angophora floribunda</i>	Australia: New South Wales	A.J. Carnegie	KF901883	–	–	–	–	–	–	–
<i>Ter. aurantia</i>	CBS 125243 = MUC 668 ^{ET}	<i>Eucalyptus grandis</i>	Australia: Queensland	G. Whyte	KF901884	–	–	–	–	–	–	–
<i>Ter. australiensis</i>	CBS 124580 = MUC 695	<i>Corymbia</i> sp.	Australia: Western Australia	G.E. St.J. Hardy	KF901885	–	–	–	–	–	–	–
	CBS 125244 = MUC 731	<i>Eucalyptus foefolia</i>	Australia	V. Andjic	KF901886	–	–	–	–	–	–	–
<i>Ter. biformis</i>	CBS 124578 = MUC 693 ^{ET}	<i>Eucalyptus globulus</i>	Australia: Queensland	G. Whyte	KF901887	–	–	–	–	–	–	–
<i>Ter. blakelyi</i>	CBS 120089 = CPC 12837 ^{ET}	<i>Eucalyptus globulus</i>	Australia: New South Wales	B.A. Summerell	KF901888	–	–	–	–	–	–	–
<i>Ter. callophylla</i>	CBS 124584 = MUC 700 ^{ET}	<i>Corymbia</i> sp.	Australia: Western Australia	K. Taylor	KF901889	–	–	–	–	–	–	–
<i>Ter. capensis</i>	CBS 130602 ^{ET}	<i>Protea</i> sp.	South Africa	P.W. Crous	JN712569	–	–	–	–	–	–	–
<i>Ter. complicata</i>	CBS 125216 = CPC 14535 ^{ET}	<i>Eucalyptus miniata</i> leaf litter	Australia: Northern Territory	B.A. Summerell	KF901890	–	–	–	–	–	–	–
	CPC 14535	<i>Eucalyptus miniata</i> leaf litter	Australia: Northern Territory	B.A. Summerell	KF902139	–	–	–	–	–	–	–
<i>Ter. considerianae</i>	CBS 120087 = CPC 12840 ^{ET}	<i>Eucalyptus consideriana</i>	Australia: New South Wales	B.A. Summerell	KF937238	–	–	–	–	–	–	–
	CPC 13032	<i>Eucalyptus</i> sp.	Australia: New South Wales	B.A. Summerell	KF901891	–	–	–	–	–	–	–
	CPC 14057	<i>Eucalyptus stellulata</i>	Australia: New South Wales	B.A. Summerell	KF901892	–	–	–	–	–	–	–
<i>Ter. corymbiae</i>	CBS 120496 = DAR 77446	<i>Corymbia maculata</i>	Australia: New South Wales	A.J. Carnegie	KF937239	–	–	–	–	–	–	–
	CBS 124988 = CPC 13125	<i>Corymbia henryi</i>	Australia: New South Wales	A.J. Carnegie	KF901893	–	–	–	–	–	–	–
<i>Ter. crispata</i>	CBS 130523 ^{ET}	<i>Eucalyptus bridgesiana</i>	Australia: New South Wales	A.J. Carnegie	KF901880	–	–	–	–	–	–	–
<i>Ter. cryptica</i>	CBS 110975 = CMW 3279 = CPC 936	<i>Eucalyptus globulus</i>	Australia: Victoria	A.J. Carnegie	KF901897	–	–	–	–	–	–	–
	CBS 111663 = CPC 1558	–	–	–	KF901823	–	–	–	–	–	–	–
	CBS 111679 = CPC 1576	<i>Eucalyptus nitens</i>	Australia: Tasmania	M.J. Wingfield	KF902037	–	–	–	–	–	–	–
	CPC 12415	<i>Eucalyptus globulus</i>	Australia: Victoria	I.W. Smith	KF902118	–	–	–	–	–	–	–
	CPC 12424	<i>Eucalyptus globulus</i>	Australia: Victoria	I.W. Smith	KF901895	–	–	–	–	–	–	–
	CPC 12559	<i>Eucalyptus nitens</i>	Australia: Tasmania	C. Mohammed	KF901894	–	–	–	–	–	–	–
	CPC 13839	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901896	–	–	–	–	–	–	–
<i>Ter. destructans</i>	CBS 111369 = CPC 1366 ^{ET}	<i>Eucalyptus globulus</i>	Indonesia	M.J. Wingfield	EU019287	–	–	–	–	–	–	–
	CBS 111370 = CPC 1368 ^{ET}	<i>Eucalyptus grandis</i>	Indonesia	M.J. Wingfield	KF901898	–	–	–	–	–	–	–
<i>Ter. dimorpha</i>	CBS 120085 = CPC 12798	<i>Eucalyptus nitens</i>	Australia: New South Wales	A.J. Carnegie	KF937240	–	–	–	–	–	–	–
	CBS 124051 = CPC 14132	<i>Eucalyptus caesia</i>	Australia: New South Wales	B.A. Summerell	KF901899	–	–	–	–	–	–	–
<i>Ter. eucalypti</i>	CBS 111692 = CMW 14910 = CPC 1582	<i>Eucalyptus</i> sp.	New Zealand	M.J. Wingfield	KF902119	–	–	–	–	–	–	–
	CPC 12552	<i>Eucalyptus nitens</i>	Australia: Tasmania	C. Mohammed	KF901900	–	–	–	–	–	–	–
<i>Ter. fibrillosa</i>	CBS 121707 = CPC 13960 ^{ET}	<i>Protea</i> sp.	South Africa	P.W. Crous & L. Mostert	KF902075	–	–	–	–	–	–	–
<i>Ter. fimbriata</i>	CBS 120736 = CPC 13324 ^{ET}	<i>Corymbia</i> sp.	Australia: Queensland	P.W. Crous	KF901901	–	–	–	–	–	–	–
	CBS 120893 = CPC 13321	<i>Corymbia</i> sp.	Australia: Queensland	P.W. Crous	KF901902	–	–	–	–	–	–	–
	CPC 13321	<i>Corymbia</i> sp.	Australia	P.W. Crous	KF901903	–	–	–	–	–	–	–
<i>Ter. foliensis</i>	CBS 124581 = MUC 670 ^{ET}	<i>Eucalyptus globulus</i>	Australia: New South Wales	S. Collins	KF901904	–	–	–	–	–	–	–
<i>Ter. gauchensis</i>	CBS 119465 = CMW 17545	<i>Eucalyptus grandis</i>	Uruguay	M.J. Wingfield	KF902145	–	–	–	–	–	–	–
	CBS 119468 = CMW 17558	<i>Eucalyptus grandis</i>	Uruguay	M.J. Wingfield	KF902146	–	–	–	–	–	–	–

	CBS 120303 = CMW 17331 ^{ET}	<i>Eucalyptus grandis</i>	Uruguay	M.J. Wingfield	KF902148	KF903521	KF902729	KF901790	KF902439	KF903315	KF903013
	CBS 120304 = CMW 17332 ^{ET}	<i>Eucalyptus grandis</i>	Uruguay	M.J. Wingfield	KF902147	KF903522	KF902728	KF901789	KF902438	KF903314	KF903012
<i>Ter. hortaea</i>	CBS 124156 = CPC 15716 ^{ET}	<i>Eucalyptus camaldulensis</i>	Madagascar	M.J. Wingfield	KF902016	KF903550	KF902730	KF901674	KF902440	KF903316	KF903014
<i>Ter. juvenalis</i>	CBS 110906 = CMW 13347 = CPC 40 ^{ET}	<i>Eucalyptus cladocalyx</i>	South Africa	P.W. Crous	KF902077	KF903409	-	KF901730	-	-	-
	CBS 111149 = CPC 23	<i>Eucalyptus cladocalyx</i>	South Africa	P.W. Crous	KF902012	KF903429	KF902731	KF901670	KF902441	KF903317	KF903015
	CBS 116427 = CPC 10941	<i>Eucalyptus cladocalyx</i>	South Africa	P.W. Crous	KF902076	KF903485	KF902732	KF901729	KF902442	KF903318	KF903016
<i>Ter. knoxdavesii</i>	CPC 14905	<i>Protea</i> sp.	South Africa	P.W. Crous	EU707866	-	-	-	-	-	-
	CBS 122898 = CPC 14960 ^{ET}	<i>Protea</i> sp.	South Africa	P.W. Crous	EU707865	-	-	-	-	-	-
<i>Ter. macowanii</i>	CBS 122901 = CPC 13899 ^{ET}	<i>Protea nitida</i>	South Africa	P.W. Crous & L. Mostert	KF937241	-	-	-	KF937276	-	-
<i>Ter. majorizuluensis</i>	CBS 120040 = CPC 12712 ^{ET}	<i>Eucalyptus botryoides</i>	Australia: New South Wales	B.A. Summerell	KF901905	KF903516	KF902733	KF901581	KF902443	KF903319	KF903017
<i>Ter. mareebensis</i>	CBS 129529 = CPC 17272 ^{ET}	<i>Eucalyptus alba</i>	Australia: Queensland	P.W. Crous & R.G. Shivas	KF901906	KF903581	KF902734	KF901582	KF902444	KF903320	KF903018
<i>Ter. maxii</i>	CBS 112496 = CPC 3322	<i>Protea</i> sp.	Australia: New South Wales	P.W. Crous & B. Summerell	KF937242	-	-	-	KF937277	-	-
	CBS 120137 = CPC 12805 ^{ET}	<i>Protea repens</i>	South Africa	M. & P.W. Crous	KF937243	-	-	-	KF937278	-	-
<i>Ter. mexicana</i>	CBS 110502 = CMW 14461	<i>Eucalyptus globulus</i>	Australia: Western Australia	A. Maxwell	KF902176	KF903397	KF902735	KF901812	KF902445	KF903321	-
<i>Ter. micromaculata</i>	CBS 124582 = MUCC 647 ^{ET}	<i>Eucalyptus globulus</i>	Australia: Queensland	G. Whyte	KF901907	KF903555	-	KF901583	KF902446	KF903322	KF903019
<i>Ter. miniata</i>	CBS 125006 = CPC 14514 ^{ET}	<i>Eucalyptus miniata</i> leaf litter	Australia: Northern Territory	B.A. Summerell	KF901908	KF903574	KF902736	KF901584	KF902447	KF903323	KF903020
	CPC 14514	<i>Eucalyptus miniata</i> leaf litter	Australia: Northern Territory	B.A. Summerell	KF937244	-	-	-	KF937279	-	-
<i>Ter. mollieriana</i>	CBS 110499 =	<i>Eucalyptus globulus</i>	Australia: Western Australia	A. Maxwell	KF901910	KF903394	KF902743	KF901586	KF902454	KF903330	KF903027
	CMW 14180 ^{ET} of <i>Nyctospheerella amorphyla</i>										
	CBS 111164 = CMW 4940 = CPC 12114 ^{ET} of <i>M. mollieriana</i>	<i>Eucalyptus globulus</i>	Portugal	S. McCrae	KF902038	KF903431	KF902737	KF901692	KF902448	KF903324	KF903021
	CBS 111165 = CPC 1215 ^{ET}	<i>Eucalyptus globulus</i>	Portugal	S. McCrae	KF902039	KF903432	KF902738	KF901693	KF902449	KF903325	KF903022
	CBS 117924 = CMW 11588	<i>Eucalyptus globulus</i>	Australia: Tasmania	-	KF902078	KF903486	KF902739	KF901731	KF902450	KF903326	KF903023
	CBS 117925 = CMW 11559	<i>Eucalyptus globulus</i>	Australia	-	KF902121	KF903487	KF902744	KF901765	KF902455	KF903331	KF903028
	CBS 117926 = CMW 11563	<i>Eucalyptus globulus</i>	Australia	-	KF902122	KF903488	KF902745	KF901766	KF902456	KF903332	KF903029
	CBS 117927 = CMW 11564	<i>Eucalyptus globulus</i>	Australia: Tasmania	-	KF902123	KF903489	KF902746	KF901767	KF902457	KF903333	KF903030
	CBS 118359 = CMW 11560	<i>Eucalyptus globulus</i>	Australia: Tasmania	-	KF902120	KF903490	KF902740	KF901764	KF902451	KF903327	KF903024
	CBS 120746 =	<i>Eucalyptus</i> sp.	Portugal	P.W. Crous & A.J.L. Phillips	-	-	-	EF394844	-	-	-
	CPC 13398 ^{EET} of <i>T. mollieriana</i>										
	CBS 122905 = CMW 2732 = CPC 355 ^{ET} of <i>T. xenocryptica</i>	<i>Eucalyptus</i> sp.	Chile	M.J. Wingfield	KF901959	KF903540	KF902741	KF901626	KF902452	KF903328	KF903025
	CPC 12232	<i>Eucalyptus globulus</i>	Portugal	A.J.L. Phillips	KF901909	KF903609	KF902742	KF901585	KF902453	KF903329	KF903026
<i>Ter. multiseptata</i>	CBS 121312 = DAR 77438 ^{ET}	<i>Angophora subvelutia</i>	Australia: New South Wales	A.J. Carnegie	KF901911	KF903537	KF902747	KF901587	KF902458	KF903334	KF903031
<i>Ter. nubilosa</i>	CBS 116005 = CMW 3282 = CPC 937	<i>Eucalyptus globulus</i>	Australia: Victoria	A.J. Carnegie	KF902031	KF903479	KF902749	KF901686	KF902460	KF903336	KF903033
	CPC 11879	<i>Eucalyptus</i> sp.	Portugal	A.J.L. Phillips	KF902040	KF903606	KF902750	KF901694	KF902461	KF903337	KF903034
	CPC 12235	<i>Eucalyptus globulus</i>	Portugal	A.J.L. Phillips	KF902041	KF903610	KF902751	KF901695	KF902462	KF903338	KF903035
	CPC 12243	<i>Eucalyptus globulus</i>	Portugal	A.J.L. Phillips	KF902042	KF903611	KF902752	KF901696	KF902463	KF903339	KF903036
	CPC 12830	<i>Eucalyptus globulus</i>	Portugal	A.J.L. Phillips	KF902043	KF903626	KF902753	KF901697	KF902464	KF903340	KF903037
	CPC 13452	<i>Eucalyptus</i> sp.	Portugal	P.W. Crous	KF902044	KF903648	KF902754	KF901698	KF902465	KF903341	KF903038
	CPC 13825	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901912	KF903662	KF902755	KF901588	KF902466	KF903342	KF903039
	CPC 13828	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901913	KF903663	KF902756	KF901589	KF902467	KF903343	KF903040
	CPC 13835	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF902169	KF903666	KF902748	KF901807	KF902469	KF903335	KF903032
	CPC 13844	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901914	KF903668	KF902757	KF901590	KF902468	KF903344	KF903041
<i>Ter. ovata</i>	CBS 124052 = CPC 14632	<i>Eucalyptus phoenicea</i>	Australia: Northern Territory	B.A. Summerell	KF901915	KF903547	-	KF901591	KF902469	KF903345	KF903042
<i>Ter. pluritubularis</i>	CBS 118508 = CPC 11697 ^{ET}	<i>Eucalyptus globulus</i>	Spain	J.P. Mansilla	KF902101	KF903504	KF902758	KF901748	KF902470	KF903346	KF903043
<i>Ter. profusa</i>	CBS 125007 = CPC 12821 ^{ET}	<i>Eucalyptus nitens</i>	Australia	A.J. Carnegie	KF901916	-	KF902759	KF901592	KF902471	KF903347	KF903044
	CPC 12821	<i>Eucalyptus nitens</i>	Australia	A.J. Carnegie	KF937245	-	-	-	KF937280	-	-
	CPC 14963	<i>Protea</i> sp.	South Africa	P.W. & M. Crous	KF937246	-	-	-	KF937281	-	-
<i>Ter. proteae-arborea</i>	CBS 118504 = CPC 11267 ^{ET}	<i>Eucalyptus</i> sp.	New Zealand	J.A. Stalpers	KF902032	KF903598	KF902760	KF901687	KF902472	KF903348	KF903045
<i>Ter. pseudocryptica</i>	CPC 11264	<i>Corymbia henryi</i>	Australia	A.J. Carnegie	KF901856	KF903640	KF902651	KF901534	KF902343	-	KF902929
<i>Ter. pseudoeucalypti</i>	CBS 124577 = MUCC 607 ^{ET}	<i>Eucalyptus grandis</i> × <i>E. camaldulensis</i>	Australia: Queensland	G.S. Pegg	KF901917	-	KF902761	KF901593	KF902473	KF903349	KF903046
<i>Ter. pseudonubilosa</i>	CPC 13831	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901918	KF903664	KF902762	KF901594	KF902474	KF903350	KF903047
	CPC 13833	<i>Eucalyptus globulus</i>	Australia	I.W. Smith	KF901919	KF903665	KF902763	KF901595	KF902475	KF903351	KF903048
<i>Ter. rubida</i>	CBS 124579 = MUCC 658 ^{ET} of <i>T. rubra</i>	<i>Corymbia calophylla</i>	Australia: Western Australia	P.A. Barber	KF901920	KF903552	KF902764	KF901596	KF902476	KF903352	KF903049
<i>Ter. stellenboschiana</i>	CBS 124989 = CPC 13767	<i>Eucalyptus punctata</i>	South Africa	P.W. Crous	KF902079	KF903561	KF902767	KF901732	KF902486	KF903355	KF903052

Table 1 (cont.)

Species	Isolate no. ^{1,2}	Host	Location	Collector	GenBank accession no. ³							
					LSU	Act	Cal	ITS	RPB2	EF-1 α	Btub	
<i>Ter. suttonii</i>	CBS 125215 = CPC 13764	<i>Eucalyptus punctata</i>	South Africa	P.W. Crous	KF937247	–	–	–	–	KF937282	–	–
	CBS 125215	<i>Eucalyptus punctata</i>	South Africa	P.W. Crous	KF902080	KF903577	KF902768	–	KF901733	KF902487	KF903356	KF903053
	CPC 12283	<i>Eucalyptus</i> sp.	France: Corsica	J. Dijksterhuis	KF901981	KF903613	KF902766	–	KF901646	KF902485	KF903354	KF903051
	CBS 110907 = CPC 63	<i>Eucalyptus grandis</i>	South Africa	P.W. Crous	KF937248	–	–	–	–	KF937283	–	–
	CBS 119973 = CMW 23439 ^{ET} of <i>Mycosphaerella obscuris</i>	<i>Eucalyptus pellita</i>	Vietnam	T.I. Burgess	KF902142	KF903513	KF902771	–	KF901784	KF902489	KF903359	KF903055
<i>Ter. syncarpiae</i>	CPC 12218	<i>Eucalyptus</i> sp.	Indonesia	M.J. Wingfield	KF902003	KF903608	KF902769	–	KF901664	KF902488	KF903357	KF903054
	CPC 12352	<i>Eucalyptus</i> sp.	USA: Hawaii	W. Gams	KF902162	–	KF902770	–	–	–	KF903358	–
	CBS 121160 = DAR 77433 ^{ET}	<i>Syncarpia glomulifera</i>	Australia: New South Wales	A.J. Carnegie & M.J. Wingfield	KF901922	KF903536	KF902772	–	KF901598	KF902490	KF903360	KF903056
	CBS 124583 = MUCC 666 ^{ET}	<i>Corymbia</i> sp.	Australia: Queensland	T.I. Burgess	KF901923	KF903556	KF902773	–	KF901599	KF902491	–	KF903057
	CBS 113313 = CMW 14457 ^{ET}	<i>Eucalyptus</i> sp.	Spain	P.W. Crous & G. Bills	KF902081	KF903464	KF902774	–	KF901734	KF902492	KF903361	KF903058
<i>Ter. veloci</i>	CBS 115513 = CPC 10840	<i>Eucalyptus</i> sp.	Spain	P.W. Crous & G. Bills	KF901924	KF903475	KF902775	–	KF901600	KF902493	KF903362	KF903059
	CBS 124061 = CPC 14602 ^{ET}	<i>Eucalyptus miniata</i>	Australia: Northern Territory	B.A. Summerell	KF937249	–	–	–	–	KF937284	–	–
	CPC 14600	<i>Eucalyptus miniata</i>	Australia: Northern Territory	B.A. Summerell	KF901925	KF903673	KF902776	–	KF901601	–	KF903363	KF903060
	CBS 113621 = CPC 42 ^{ET}	<i>Eucalyptus cladocalyx</i>	South Africa	P.W. Crous	KF901980	KF903465	KF902778	–	KF901645	KF902495	KF903365	KF903062
	CPC 12949	<i>Eucalyptus</i> sp.	South Africa	P.W. Crous	KF902124	KF903629	KF902777	–	KF901768	KF902494	KF903364	KF903061
<i>Ter. zuluensis</i>	CBS 121157 = MUCC 453 ^{ET}	<i>Eucalyptus grandis</i>	Australia: Queensland	T.I. Burgess, G.E. St. J. Hardy, A.J. Carnegie & G. Pegg	KF901927	–	–	–	–	–	KF903367	–
	CBS 124992 = CPC 13306	<i>Eucalyptus</i> sp.	Australia: Queensland	B.A. Summerell & P.W. Crous	KF901926	KF903563	KF902779	–	KF901602	KF902496	KF903366	KF903063
	CBS 120301 = CMW 17321 ^{ET}	<i>Eucalyptus grandis</i>	South Africa	M.J. Wingfield	KF902082	KF903519	KF902780	–	KF901735	KF902497	KF903368	KF903064
	CBS 120302 = CMW 17322 ^{ET}	<i>Eucalyptus grandis</i>	South Africa	M.J. Wingfield	KF902083	KF903520	KF902781	–	KF901736	KF902498	KF903369	KF903065
	CBS 111168 = CPC 1231	<i>Eucalyptus globulus</i>	Zambia	T. Coutinho	KF902045	KF903435	KF902782	–	KF901699	KF902499	KF903370	KF903066
<i>Teratosphaeriopsis pseudoafricana</i>	CBS 114782 = CPC 1230 ^{ET}	<i>Eucalyptus globulus</i>	Zambia	T. Coutinho	KF902084	KF903473	KF902783	–	KF901737	KF902500	KF903371	KF903067
	CBS 111171 = CPC 1261	<i>Eucalyptus</i> sp.	South Africa	P.W. Crous	KF902085	KF903436	KF902784	–	KF901738	KF902501	KF903372	KF903068
	CBS 117937 = TRN211	Rock sample	Spain	W. Gams	GU323978	–	–	–	–	KF310038	–	–
	CBS 120744 = CPC 12349	<i>Eucalyptus</i> sp.	USA: Hawaii	A.P.M. Duarte, N.C. Baron & D.A. de Angelis	KF902160	KF903532	KF902546	–	KF901800	KF902215	KF903110	KF902810
	CBS 131961	Ant body	Brazil	D.A. de Angelis	KF902172	–	–	–	–	KF902478	–	–
<i>Teratosphaeriaceae</i> sp.	CBS 131960	Ant body	Brazil	A.P.M. Duarte, N.C. Baron & D.A. de Angelis	KF901950	–	–	–	–	KF902479	–	–
	CBS 131962	Ant body	Brazil	A.P.M. Duarte, N.C. Baron & D.A. de Angelis	KF901951	–	–	–	–	KF902480	–	–
	CBS 131963	Ant body	Brazil	A.P.M. Duarte, N.C. Baron & D.A. de Angelis	KF901952	–	–	–	–	KF902481	–	–
	CBS 131976	Ant body	Brazil	A.P.M. Duarte, N.C. Baron & D.A. de Angelis	KF901953	–	–	–	–	KF902482	–	–
	CBS 131977	Ant body	Brazil	A.P.M. Duarte, N.C. Baron & D.A. de Angelis	KF901954	–	–	–	–	KF902483	–	–
<i>Teratosphaeriaceae</i> sp.	CBS 131979	Ant body	Brazil	A.P.M. Duarte, N.C. Baron & D.A. de Angelis	KF901955	–	–	–	–	KF902484	–	–
	CFFE 5569	Rock sample	Italy	D.A. de Angelis	KF310015	–	–	–	–	KF310071	–	–
	CPC 13680	<i>Eucalyptus plácita</i>	Australia	B.A. Summerell	KF901921	KF903657	KF902765	–	KF901597	KF902477	KF903353	KF903050
	TRN232	Rock sample	Spain	–	KF310011	–	–	–	–	KF310079	–	–
	TRN450	Rock sample	Spain	–	KF937237	–	–	–	–	–	–	–
<i>Toxicocladosporium irritans</i>	CBS 128777 = CPC 18471 ^{ET}	<i>Phaenocoma prolifera</i>	South Africa	K. L. & P.W. Crous	HQ599587	–	–	–	–	KJ564345	–	–
	CBS 126499 = CPC 15254 ^{ET}	<i>Protea burckelii</i>	South Africa	F. Roets	FJ790305	–	–	–	–	KJ564344	–	–
	CBS 124158 = CPC 15735 ^{ET}	<i>Eucalyptus camaldulensis</i>	Madagascar	M. J. Wingfield	KF902008	–	–	–	–	KJ564338	–	–
	CBS 437.68	<i>Citrus</i> sp.	Java	J.H. van Emden	KJ380895	–	–	–	–	KF902502	–	–
	CFFE 5772	Rock sample	France	D. Tesel	GU323974	–	–	–	–	KJ380901	–	–
Undescribed species	CBS 118301 = TRN138	Rock sample	Spain	C. Ruibal	GU323974	–	–	–	–	KJ564343	–	–
	CBS 118305 = TRN62	Rock sample	Spain	C. Ruibal	GU323961	–	–	–	–	KF310084	–	–

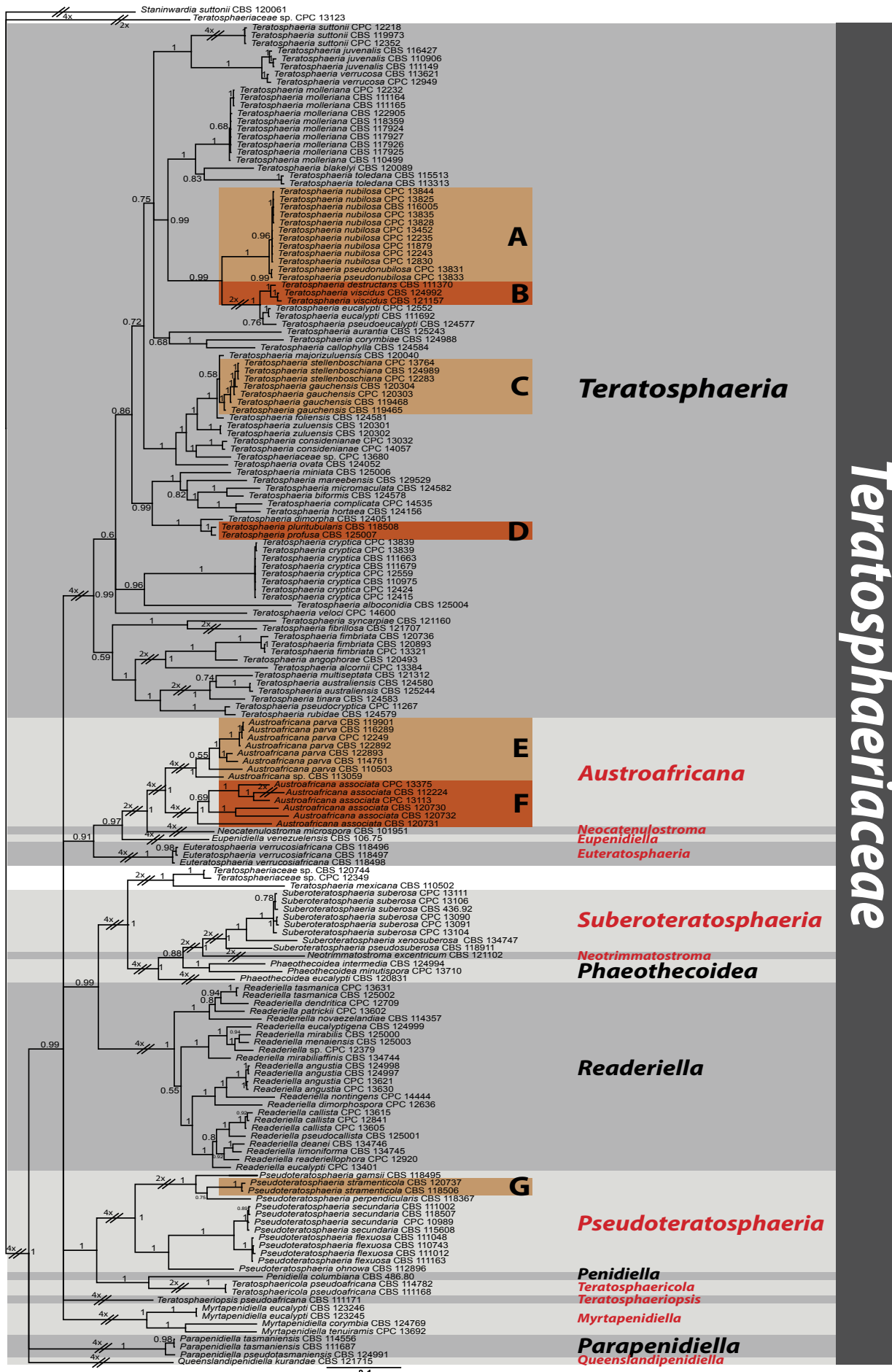


Fig. 1 A Bayesian 50 % majority rule consensus tree based on a combined ITS, LSU, RPB2, EF-1 α and Btub alignment, containing all isolates associated with Teratosphaeria leaf disease of *Eucalyptus* available at the CBS. Bayesian posterior probabilities support values for the respective nodes are displayed in the tree. The tree was rooted to *Staninwardia suttonii*. The scale bar indicates 0.1 expected changes per site.

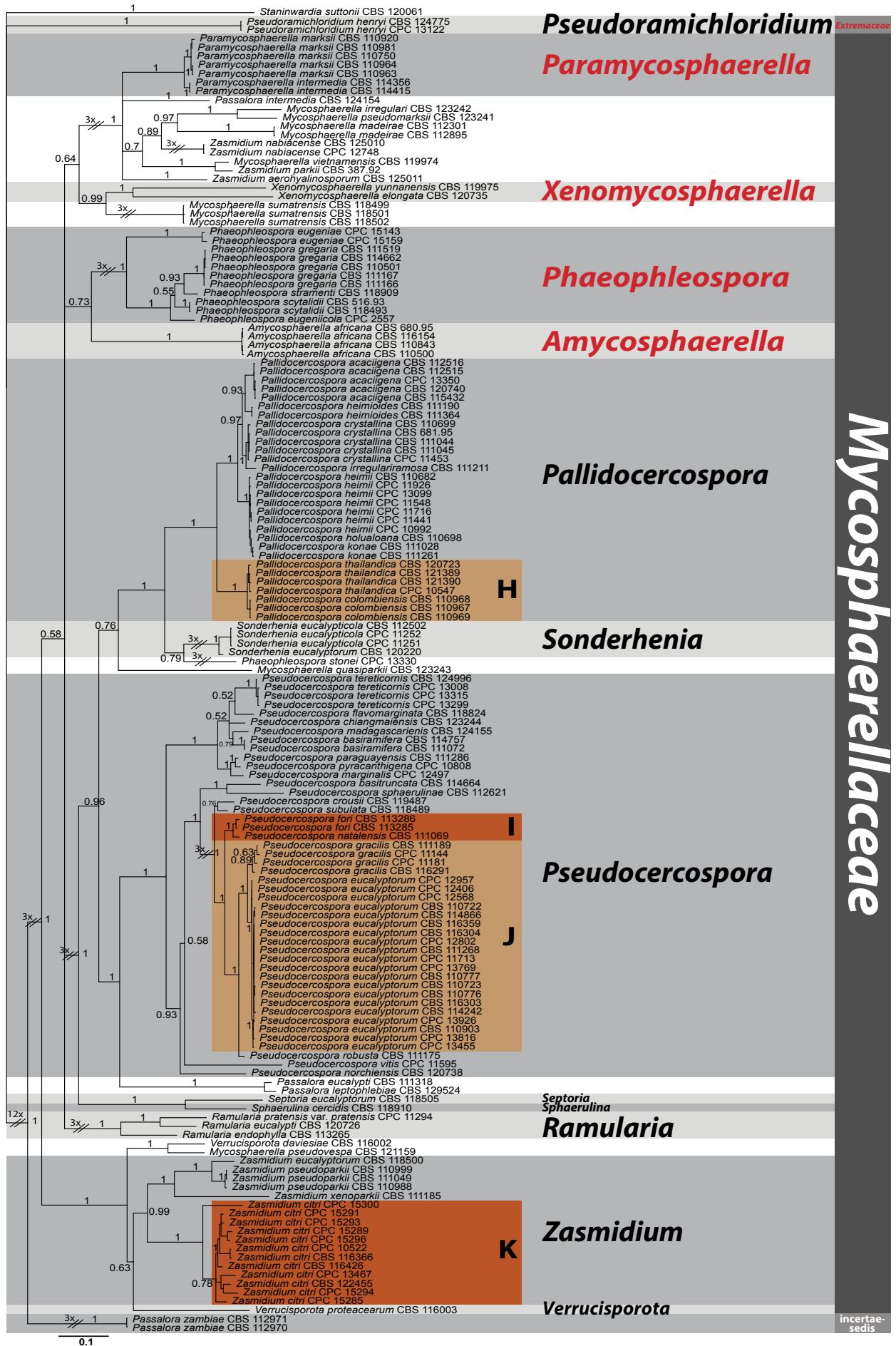


Fig. 2 A Bayesian 50% majority rule consensus tree based on a combined ITS, LSU, RPB2, EF-1 α and Act alignment, containing all isolates associated with Mycosphaerella leaf disease of *Eucalyptus* available at the CBS. Bayesian posterior probabilities support values for the respective nodes are displayed in the tree. The tree was rooted to *Staninwardia suttonii*. The scale bar indicates 0.1 expected changes per site.

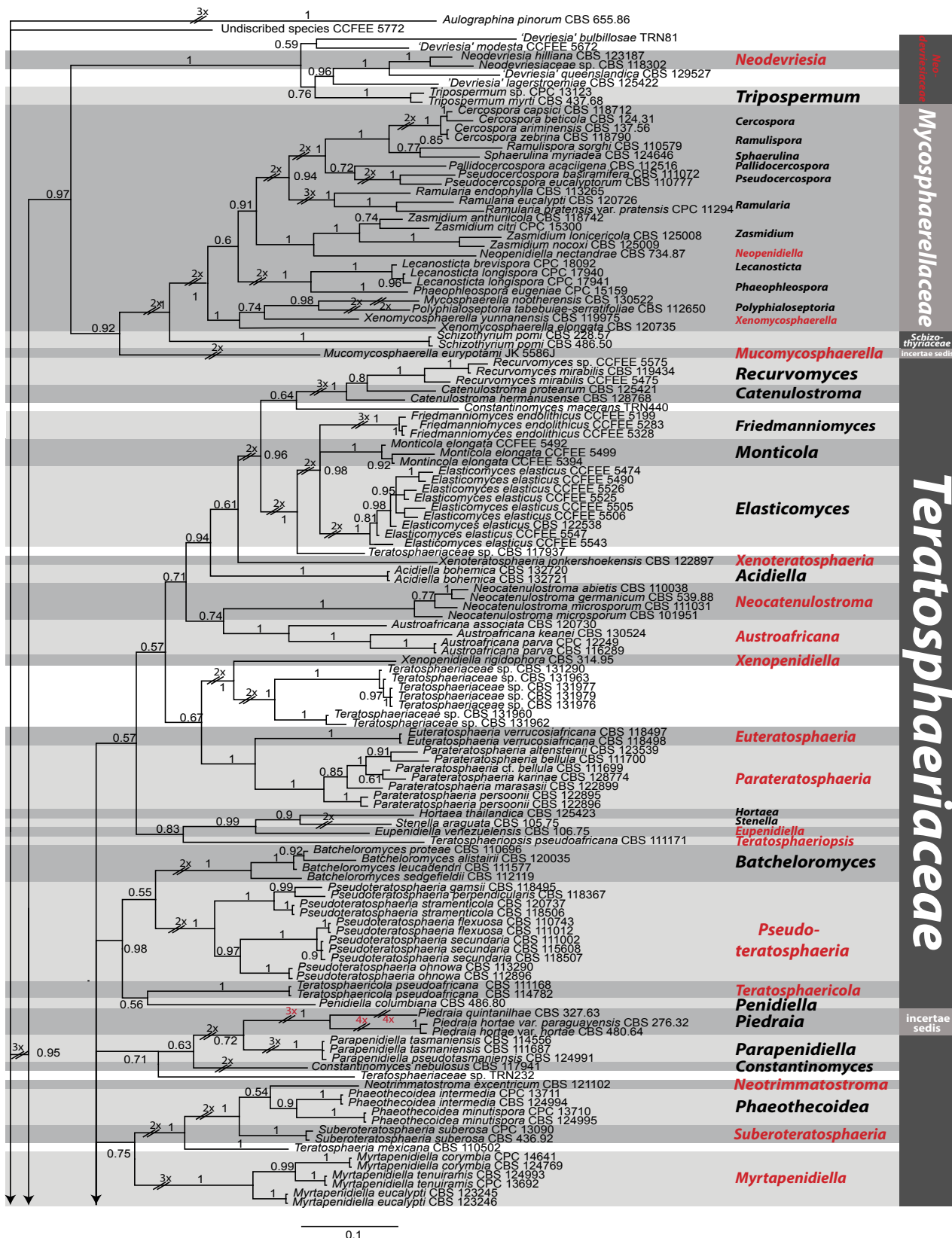


Fig. 3 A Bayesian 50% majority rule consensus tree based on the LSU/RPB2 alignment and containing all isolates associated with the *Teratosphaeriaceae* available at the CBS. Bayesian posterior probabilities support values for the respective nodes are displayed in the tree. The tree was rooted to *Aulographina pinorum*. The scale bar indicates 0.1 expected changes per site.

value for the topological convergence diagnostic set to 0.01) were performed on the five-locus (ITS, LSU, RPB2, EF-1 α and Btub) TLD (Fig. 1) and MLD (Fig. 2) trees, as well as on the two-locus, *Teratosphaeriaceae* and families LSU/RPB2 (Fig. 3, 4) concatenated datasets using MrBayes v. 3.2.1 (Ronquist et al. 2011) as described by Crous et al. (2006). Appropriate gene models were selected using MrModeltest v. 2.3 (Nylander

2004) and applied to each gene partition. The substitution models for each locus are listed in Table 3. *Staninwardia sut-tonii* (CBS 120061) served as an outgroup for both MLD and TLD five-locus multigenic phylogenetic analyses; *Aulographina pinorum* (CBS 655.86) was used as outgroup for the LSU/RPB2 *Teratosphaeriaceae* tree and *Parastagonospora nodorum* (CBS 110109) was used as an outgroup for the families tree.

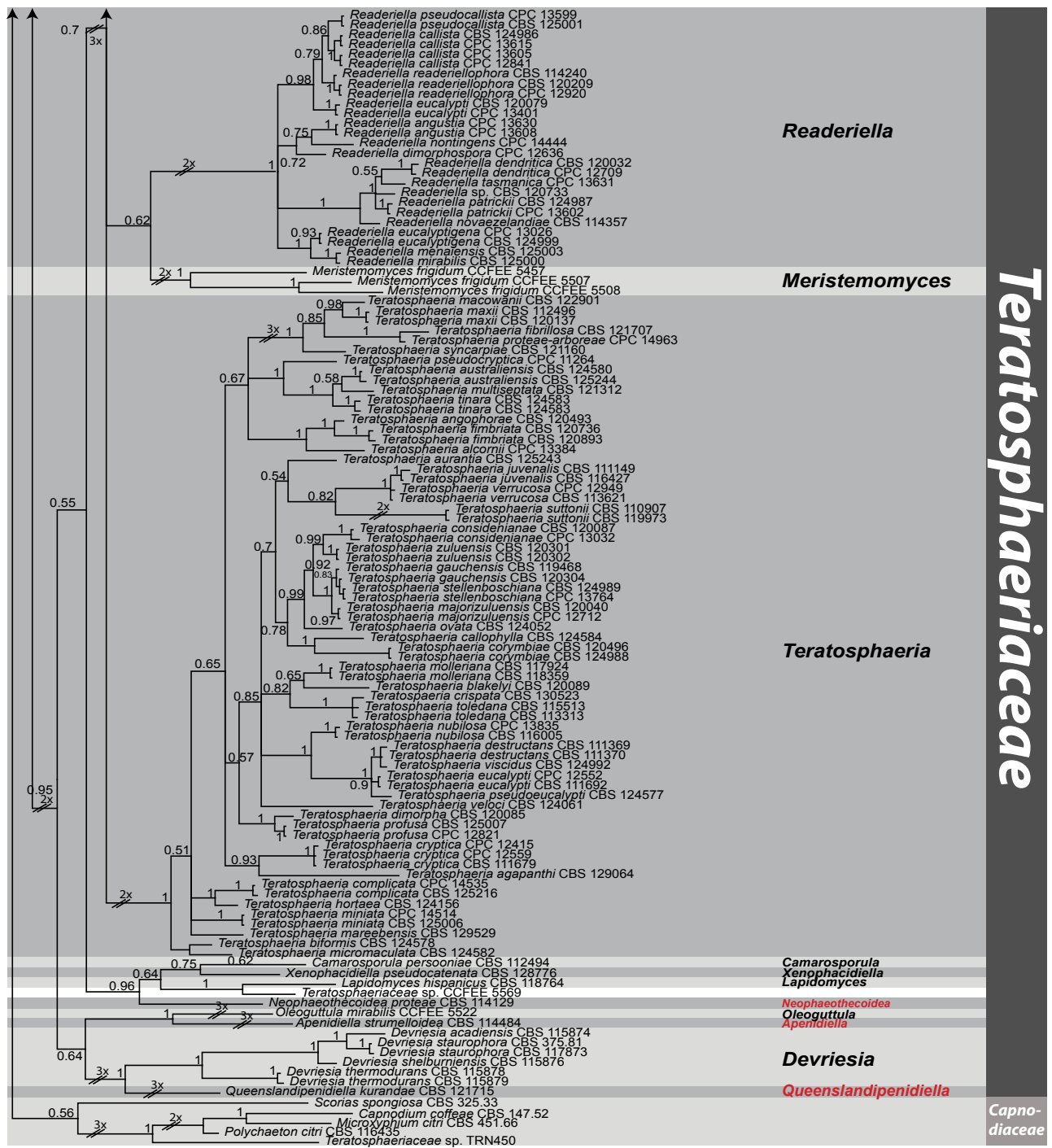


Fig. 3 (cont.)

0.1

Table 2 Primer combinations used during this study for generic amplification and sequencing.

Locus	Primer	Primer sequence 5' to 3'	Annealing temperature (°C)	Orientation	Reference
Translation elongation factor-1α	EF1-728F	CATCGAGAAGTTCGAGAAGG	52	Forward	Carbone & Kohn (1999)
	EF-2	GGARGTACCAGTSATCATGTT	52	Reverse	O'Donnell et al. (1998)
β-tubulin	T1	AACATCGCTGAGATTGTAAT	52	Forward	O'Donnell & Cigelnik (1997)
	β-Sandy-R	GRCGNGGVACRTACTTGT	52	Reverse	Stukenbrock et al. (2012)
RNA polymerase II second largest subunit	fRPB2-5F	GAYGAYMGWGATCAYTYGG	49	Forward	Liu et al. (1999)
	fRPB2-414R	ACMANNCCCCARTGNWRTRTG	49	Reverse	Quaedvlieg et al. (2011)
LSU	LSU1Fd	GRATCAGGTAGGRATACCCG	52	Forward	Crous et al. (2009a)
	LR5	TCCTGAGGGAAACTTCG	52	Reverse	Vilgalys & Hester (1990)
ITS	ITS5	GGAAGTAAAAGTCGTAACAAGG	52	Forward	White et al. (1990)
	ITS4	TCCTCCGCTTATTGATATGC	52	Reverse	White et al. (1990)
Actin	ACT-512F	ATGTGCAAGGCCGTTTCGC	52	Forward	Carbone & Kohn (1999)
	ACT2Rd	ARRTCRGDCCRCGCATGTC	52	Reverse	Groenewald et al. (2013)
Calmodulin	CAL-235F	TTCAAGGAGGCCTTCCCTCTT	50	Forward	Quaedvlieg et al. (2012)
	CAL2Rd	TGRTNGCCTDCGGATCATCTC	50	Reverse	Groenewald et al. (2013)

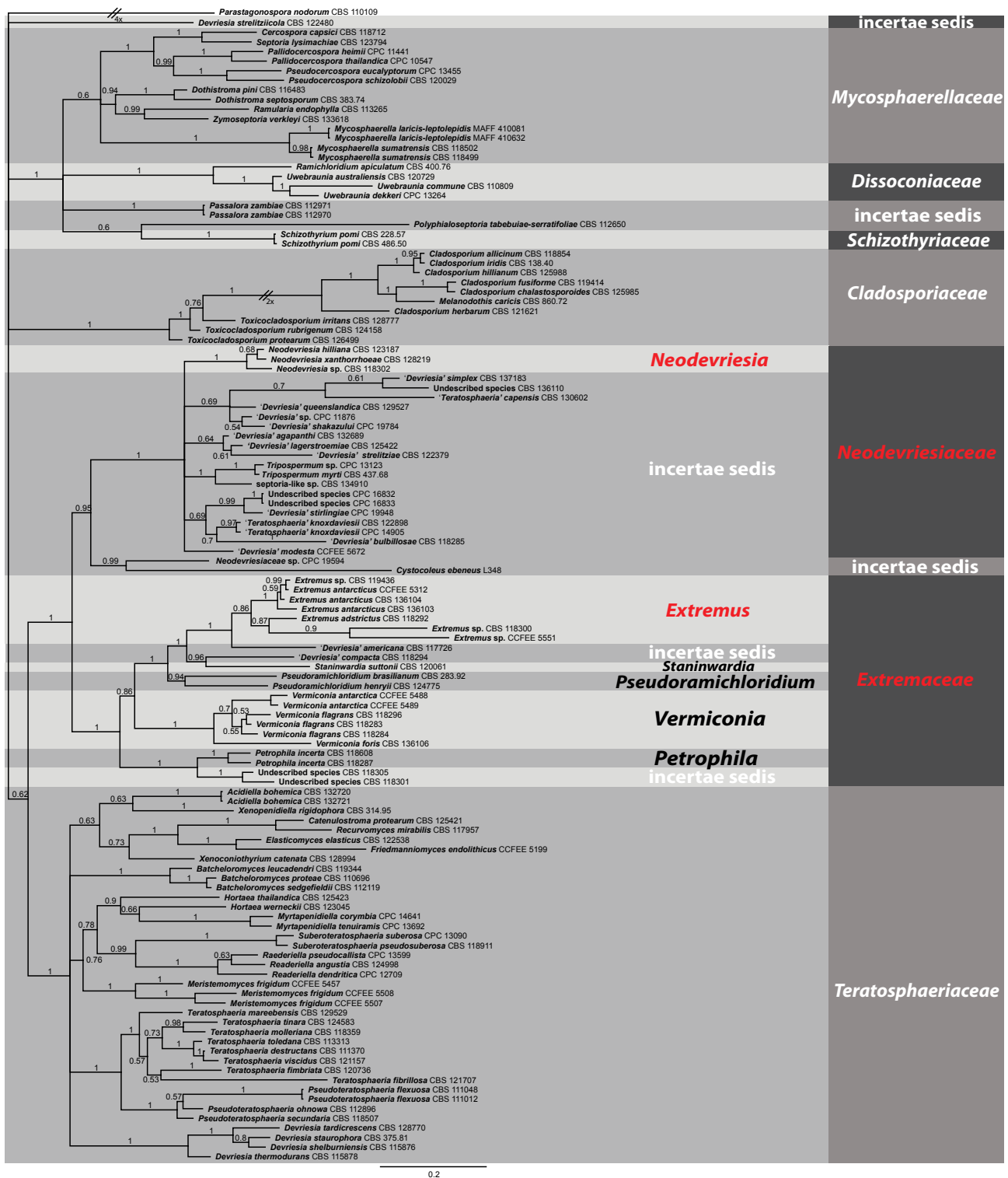


Fig. 4 A Bayesian 50 % majority rule consensus tree based on a LSU/RPB2 alignment and containing isolates that were previously associated with 'Teratosphaeria 1' and '2', plus representatives of closely related families, available at the CBS. Bayesian posterior probabilities support values for the respective nodes are displayed in the tree. The tree was rooted to *Parastagonospora nodorum*. The scale bar indicates 0.2 expected changes per site.

Kimura-2-parameter values

The available sequence data from the seven individual loci within the two *Teratosphaeriaceae* and single *Mycosphaerellaceae* datasets were individually pooled together and realigned using MAFFT to generate seven single locus alignments. MEGA v. 4.0 (Tamura et al. 2007) was then used to generate both inter- and intra-specific Kimura-2-parameter distance values for these seven datasets using the pair-wise deletion model. Microsoft Excel 2007 was then used to sort these distance values into distribution bins (from distance 0–1 with intervals of 0.05 between bins) and the frequency of entries for each individual

bin was subsequently plotted against the Kimura-2-parameter distance of each bin (Fig. 5).

Genealogical concordance phylogenetic species recognition analysis

Phylogenetically related but ambiguous species were analysed separately using the Genealogical Concordance Phylogenetic Species Recognition (GCPSR) model (as described by Taylor et al. 2000) by performing a pairwise homoplasy index (Φ_w) test. GCPSR is a pragmatic tool for the assessment of species limits, as the concordance of gene genealogies is a valuable

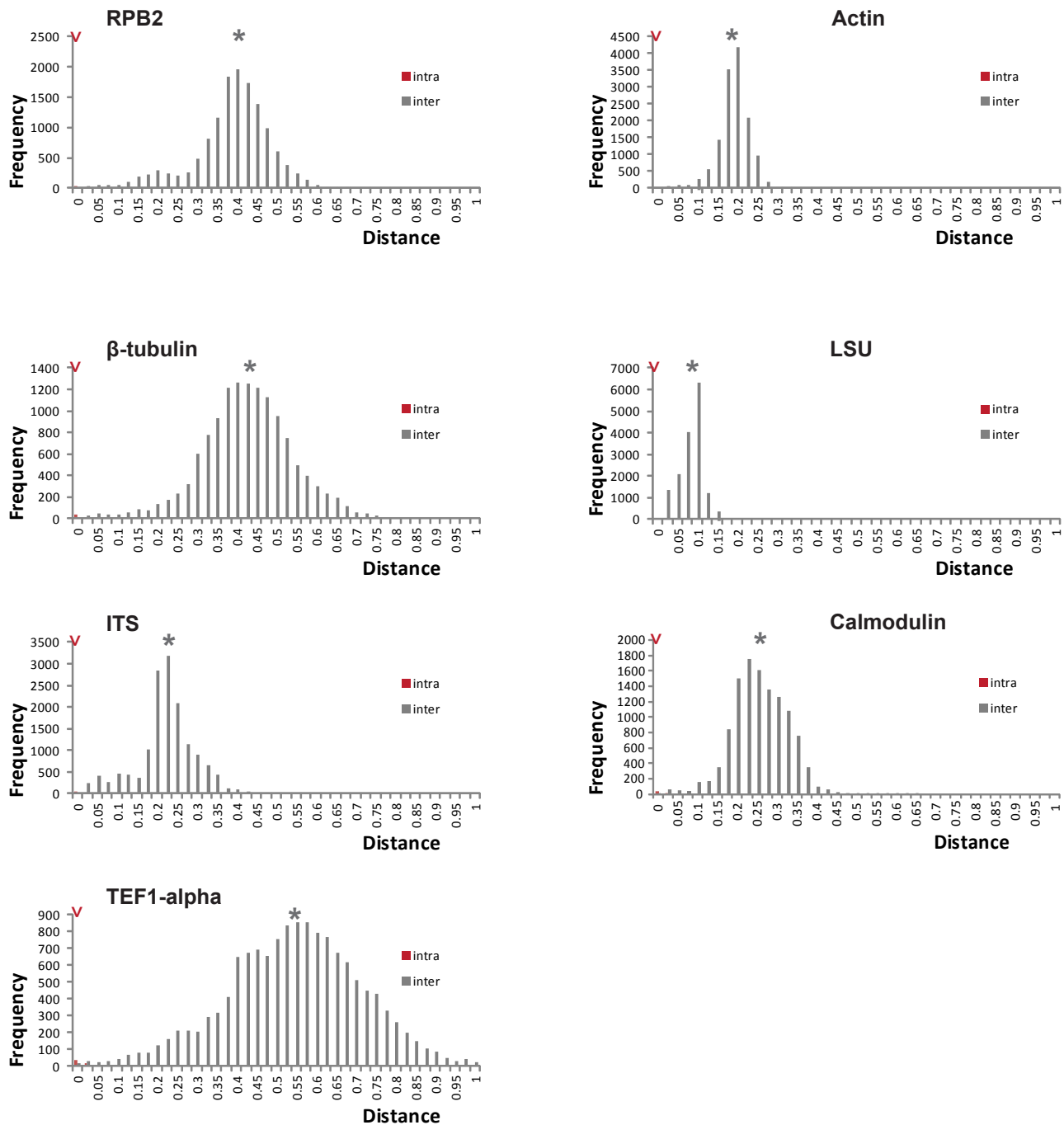


Fig. 5 The frequency distribution graphs of the Kimura-2-parameter distances (barcoding gaps) for the seven individual gene loci. The grey asterisk (*) marks the average interspecific variation per locus while red inverted chevrons (V) mark the average intraspecific variation per locus.

method for evaluating the significance of gene flow between groups within an evolutionary timescale (Koufopanou et al. 1997, Geiser et al. 1998, Taylor et al. 2000, Starkey et al. 2007). A Pairwise homoplasy index (PHI) test (Philippe & Bryant 2006) was performed in SplitsTree4 (Huson 1998, Huson & Bryant 2006) (www.splitstree.org) in order to determine the recombination level within phylogenetically closely related species using a five-locus concatenated dataset of closely related species (Fig. 1 and 2, clade A–K). If the pairwise homoplasy index results were below a 0.05 threshold ($\Phi_w < 0.05$), it was indicative for significant recombination present in the dataset. The relationships between these eleven, closely related, species groups were visualised by constructing splits graphs (Fig. 6) from the five-locus concatenated datasets, using both the Log-Det transformation and splits decomposition options.

Morphology

Morphological descriptions were made on slide preparations mounted in clear lactic acid from colonies sporulating on MEA, PDA and OA (noted in taxonomic descriptions). Observations were made with a Zeiss V20 Discovery stereo-microscope and with a Zeiss Axio Imager 2 light microscope using differential interference contrast (DIC) illumination and a MRc5 camera and ZEN imaging software. Colony characters and pigment production were noted after 1 mo of growth on MEA, PDA and OA incubated at 25 °C. Colony colours (surface and reverse) were rated according to the colour charts of Rayner (1970). Sequences derived in this study were lodged at GenBank, the alignment in TreeBASE (www.treebase.org) and taxonomic novelties in MycoBank (www.Mycobank.org; Crous et al. 2004a).

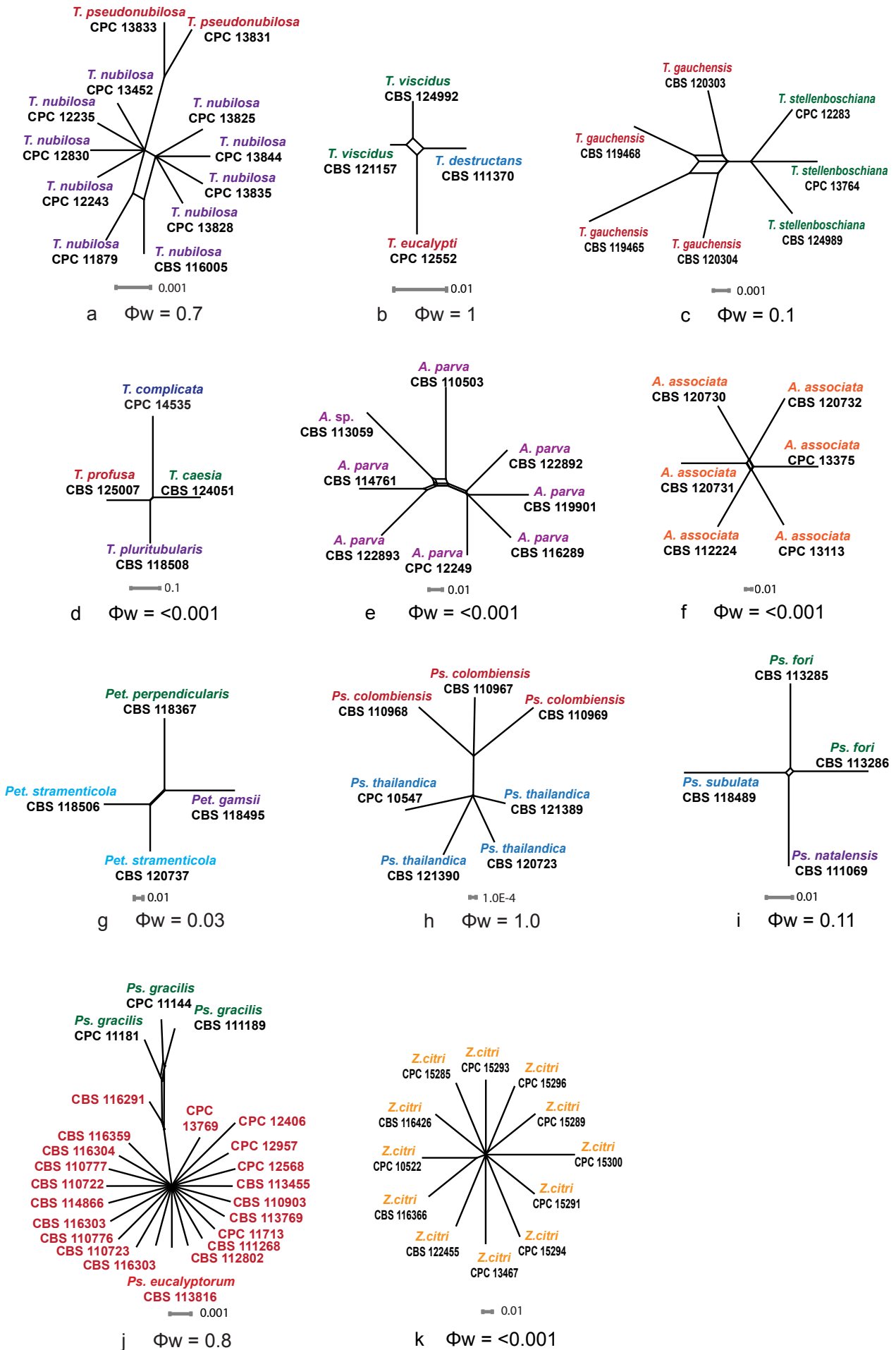


Fig. 6 The results of the pairwise homoplasmy index (PHI) test of closely related species using both LogDet transformation and splits decomposition. PHI test results (Φ_w) < 0.05 indicate significant recombination within the dataset.

Table 3 Amplification success, phylogenetic data and the substitution models used in the phylogenetic analyses, per locus.

Locus	Act	Cal	EF1	RPB2	Btub	ITS	LSU
Amplification success (%)	90	84	98	95	97	100	100
Number of characters	558	593	490	340	306	594	758
Unique site patterns	334	386	388	195	211	334	174
Substitution model used	GTR-I-gamma	HKY-I-gamma	HKY-I-gamma	GTR-I-gamma	HKY-I-gamma	GTR-I-gamma	GTR-I-gamma

RESULTS

Amplification rate of test loci

The amplification success scores of the seven test loci varied from 100 % for LSU and ITS to 84 % for Cal. The remaining four test loci (Act, RPB2, Btub and EF-1 α) produced PCR success scores of 90, 95, 97 and 98 %, respectively (Table 3).

Congruency testing

The results of the congruency test (trees not shown) showed that the seven gene regions were incongruent in both the MLD and TLD trees. In the TLD *Teratosphaeriaceae* tree (Fig. 1), the Act and Cal loci were incongruent with the other five loci, while in the MLD *Mycosphaerellaceae* tree (Fig. 2), the Btub and Cal loci were incongruent with the other five loci. In both these datasets, the terminal clades representing genera were the same for all gene regions, however the higher order clustering deviated for the incongruent loci. For this reason, the conflicting loci were not included in the published trees.

Kimura-2-parameter values

The Kimura-2-parameter (K2P) distribution graphs (Fig. 5) visualise the inter- and intraspecific distances per locus corresponding to the barcoding gap (Hebert et al. 2003). A useful barcoding locus should have no overlap between inter- and intraspecific K2P distances. The individual test loci showed varying degrees of overlap in their K2P distribution graphs. In this dataset, both ITS and LSU have a higher K2P overlap than the other five test loci suggesting they are more conserved making them less suitable to serve as a reliable identification locus for MLD and TLD pathogens across the whole scale of tested sequences. Of the remaining five loci (Btub, Act, RPB2, EF-1 α and Cal), Btub, EF-1 α and RPB2 have the lowest K2P overlap. Although these latter loci are less conserved, they show greater natural variation between different species than the other four loci.

Phylogenetic results

Based on the phylogenetic data (Fig. 1–4) generated during this study, we were able to make a start at delineating the *Teratosphaeriaceae*. Recognised clades, as well as novel species, genera and families are described and discussed in the Taxonomy section below.

The four datasets consisted of 2 468 characters for the TLD tree (753 characters for LSU, 485 for EF-1 α , 589 for ITS, 301 for Btub and 340 for RPB2), 2 950 characters for the MLD tree (563 characters for Act, 752 for LSU, 573 for EF-1 α , 728 for ITS and 334 for RPB2), 1 129 characters for the *Teratosphaeriaceae* tree (817 characters for LSU and 312 for RPB2) and 956 characters for the families tree (688 for LSU and 268 for RPB2).

The respective alignments included 1 361 parsimony-informative characters for the TLD tree (223 for LSU, 388 for EF-1 α , 334 for ITS, 221 for Btub and 195 for RPB2), 1 398 parsimony-informative characters for the MLD tree (293 for Act, 179 for LSU, 382 for EF-1 α , 355 for ITS and 189 for RPB2), 647 parsimony-informative characters for the *Teratosphaeriaceae* tree (457 for LSU and 190 for RPB2) and 511 parsimony-informative characters for the families tree (287 for LSU and 224 for RPB2).

After topological convergence of the Bayesian runs at 0.01, the following numbers of trees were generated and subsequently sampled (using a burn in fraction of 0.25 and indicated after the slash) in order to generate the three Bayesian phylogenies, 960/720 for TLD, 1102/828 for MLD, 76126/57096 for *Teratosphaeriaceae* and 9172/6879 for the families tree. The resulting phylogenetic trees of all three individual combined datasets showed consistent clustering of all MLD and TLD taxa over all four trees, and these results are treated below. There were some problems with the clustering position of the *Piedraiaceae*, and this issue is addressed in the Discussion.

TAXONOMY

Extremaceae

Extremaceae Quaedvlieg & Crous, *fam. nov.* — MycoBank MB808049

Type genus. *Extremus* Quaedvlieg & Crous.

Asexual morphs variable, filamentous, lichenicolous or yeast-like. *Conidiophores* pigmented, solitary to sporodochial, proliferating sympodially, or with a terminal rachis that can be subdenticulate. *Conidia* brown, solitary or in short mostly unbranched chains, subcylindrical to narrowly fusoid-ellipsoidal or obclavate, rarely with 1–2 transverse septa, frequently with mucoid sheath; hila not to slightly darkened, somewhat thickened and refractive or not.

Notes — Members of *Extremaceae* occur in extreme habitats, and are ecologically highly diverse, ranging from lichenicolous to epiphyllous, acidophilic, rock inhabiting, endophytic, saprobic or plant pathogenic, representing part of ‘*Teratosphaeriaceae* 2’ (now *Neodevriesiaceae* and *Extremaceae*) sensu Ruibal et al. (2009).

Extremus Quaedvlieg & Crous, *gen. nov.* — MycoBank MB808050

Type species. *Extremus adstrictus* (Egidi & Onofri) Quaedvlieg & Crous.

Etymology. Named after its ecologically extreme, rock-inhabiting habitat.

Hyphomycetous, rock-inhabiting. *Colonies* with brown, branched, thick-walled, septate hyphae. *Conidiogenous cells* integrated in hyphal chains, brown, subcylindrical to ellipsoid, smooth to rough, proliferating sympodially. *Conidia* medium brown, smooth to rough, subcylindrical to ellipsoid, thick-walled, in chains, with or without darkened median septa, at times with oblique septa; hila not to slightly darkened. *Sexual morph* unknown.

Notes — *Extremus* is introduced as novel genus to accommodate fungal species isolated from rocks. Presently its morphology is only known from culture, where it appears to be extremely slow-growing, forming brown hyphae with disarticulating conidial chains. It clusters as a sister clade that are devriesia-like in morphology, namely *D. americana* (isolated from air, USA) and *D. compacta* (isolated from rocks, Spain), suggesting that these rock-inhabiting species could be aerially dispersed.

Extremus adstrictus (Egidi & Onofri) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB808051

Basionym. *Devriesia adstricta* Egidi & Onofri, *Fung. Diversity* 65: 150. 2014.

Specimen examined. SPAIN, Mallorca, from rock, holotype CBS 118292 = TRN96, preserved in liquid nitrogen and in dried condition.

Extremus antarcticus (Selbmann & de Hoog) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB808052

Basionym. *Devriesia antarctica* Selbmann & de Hoog, *Fung. Diversity* 65: 150. 2014.

Specimen examined. ANTARCTICA, Linnaeus Terrace, from rock, holotype CBS 136103 = CCFEE 451, preserved in liquid nitrogen and in dried condition.

Incertae sedis (Capnodiales)

Mucomyosphaerella Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807791

Type species. *Mucomyosphaerella euryptami* (Kohlm., Volkm.-Kohlm. & O.E. Erikss.) Quaedvlieg & Crous.

Etymology. Resembling the genus *Mycosphaerella*, except ascospores have mucoid sheaths.

Foliicolous. *Ascomata* pseudothecial, depressed ellipsoidal, immersed becoming erumpent, with central ostiole lacking periphyses, brown, dark brown at the ostiole, solitary or in clusters of two or more joined together; wall of *textura angularis*, consisting of 4–6 layers at the top, but only 2–3 layers at the sides and bottom. *Hamathecium* sparse, composed of branched and anastomosing septate pseudoparaphyses embedded in a gelatinous matrix. *Asci* ellipsoidal to ovoid, 8-spored, indistinctly pedicellate, bitunicate, fissitunicate, thick-walled, with a thin, tough ectotunica and a thick gelatinous, expanding endotunica. *Ascospores* bi- to triseriate, elongate ellipsoidal, sometimes inequilateral, 1-septate, with one additional pseudoseptum in each cell, slightly constricted at the septum, hyaline, guttulate, surrounded by a gelatinous sheath that is constricted around the septum.

Mucomyosphaerella euryptami (Kohlm., Volkm.-Kohlm. & O.E. Erikss.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807792

Basionym. *Mycosphaerella euryptami* Kohlm., Volkm.-Kohlm. & O.E. Erikss., *Bot. Mar.* 42, 6: 505. 1999.

Specimen examined. USA, North Carolina, Virginia, Carteret County, Broad Creek, N34°43', W76°55'07", on senescent leaves of *Juncus roemerianus*, 21 May 1996, B. & J. Kohlmeyer (holotype JK5586 in IMS, culture ex-type JK5586J).

Notes — *Mucomyosphaerella* is distinguished from *Mycosphaerella* s.str. by having well developed, persistent mucoid sheaths around its ascospores, and the absence of *Ramularia* asexual states. Its *ascomata* are depressed, and have a pale, thin-walled lower half, and a *hamathecium* of loosely branched, anastomosing hyphae in a hymenial gel, with hyaline ascospores (Kohlmeyer et al. 1999). *Mucomyosphaerella euryptami* was included in *Mycosphaerella* as a temporary measure, until a formal revision of the genus (Kohlmeyer et al. 1999), which has been ongoing since the epitypification of the type species (Verkley et al. 2004), and the segregation of various allied genera and families (Crous et al. 2007b, 2009b).

The genus *Mucomyosphaerella* appears to represent a distinct family in the *Capnodiales*, sister to the *Schizothyriaceae*. More collections of additional taxa are needed to determine

the extent of morphological variation before a formal family can be introduced.

Mycosphaerellaceae

Neopenidiella Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807778

Type species. *Neopenidiella nectandrae* (Crous, U. Braun & R.F. Castañeda) Quaedvlieg & Crous.

Etymology. Named after its morphological similarity to the genus *Penidiella*.

Foliicolous. *Conidiophores* erect, straight, filiform, pluriseptate throughout, brown, darker below and paler above, thin-walled, smooth, apex penicillate, terminal cell of the conidiophore with short denticle-like loci giving rise to sets of conidiogenous cells or ramoconidia that then form a sequence of new sets of ramoconidia at different levels. *Conidiogenous loci* terminal or subterminal, usually 1–3(–4), subdenticulate, conical, apically truncate, mostly unthickened, slightly darkened-refractive. *Ramoconidia* with truncate base, barely or distinctly attenuated at the truncate base, aseptate, with 2–3(–4) subdenticulate hila at the apex, subcylindrical, pale olivaceous to olivaceous-brown or brown, thin-walled, smooth to faintly verruculose. *Conidia* in long acropetal chains, narrowly ellipsoid-ovoid, fusiform to cylindrical aseptate, pale olivaceous to olivaceous-brown or brown, thin-walled, smooth to faintly rough-walled; hila unthickened or almost so, slightly darkened-refractive.

Neopenidiella nectandrae (Crous, U. Braun & R.F. Castañeda) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807779

Basionym. *Penidiella nectandrae* Crous, U. Braun & R.F. Castañeda, *Stud. Mycol.* 58: 20. 2007.

Specimen examined. CUBA, Matanzas, San Miguel de los Baños, isolated from living leaves of *Nectandra coriacea* (*Lauraceae*), 24 Jan. 1987, R.F. Castañeda & G. Arnold, holotype INIFAT C87/45, culture ex-type CBS 734.87, and HAL 2018F.

Notes — Similar to *Penidiella*, but distinct in that conidiophores are long and filiform, ending in a subdenticulate apical cell that gives rise to sets of penicillate conidiogenous cells or ramoconidia. Ramoconidia and conidia are aseptate, pale olivaceous and consistently narrow. *Penidiella* has penicillate conidiophores with well-developed apical branches, and wider, 0–1-septate ramoconidia and conidia.

Amycosphaerella Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807780

Type species. *Amycosphaerella africana* (Crous & M.J. Wingf.) Quaedvlieg & Crous.

Etymology. Named after the genus *Mycosphaerella*, to which it is morphologically similar.

Foliicolous, plant pathogenic. *Ascomata* pseudothecial, amphigenous, solitary, black, subepidermal, globose, with central apical ostioles, becoming papillate; walls of 2–3 layers of medium brown *textura angularis*, subhymenium of 1–2 layers of hyaline cells. *Asci* obovoid to broadly ellipsoidal, straight or incurved, 8-spored. *Ascospores* bi- to triseriate, overlapping, hyaline, guttulate, straight, fusoid-ellipsoidal with obtuse ends, widest in middle of apical cells, medianly 1-septate, tapering toward both ends, but more prominently toward base.

Notes — Similar to species of *Mycosphaerella* based on morphology, distinct in that it does not produce a *Ramularia* asexual morph. *Amycosphaerella* is reliably distinguished from other genera in the family based on its DNA phylogeny, and either ITS or LSU sequence data differentiates these genera.

Amycosphaerella africana (Crous & M.J. Wingf.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807781

Basionym. *Mycosphaerella africana* Crous & M.J. Wingf., *Mycologia* 88, 3: 450. 1996.

≡ *Teratosphaeria africana* (Crous & M.J. Wingf.) Crous & U. Braun, *Stud. Mycol.* 58: 8. 2007.

= *Mycosphaerella ellipsoidea* Crous & M.J. Wingf., *Mycologia* 88: 452. 1996.

= *Mycosphaerella aurantia* A. Maxwell, *Mycol. Res.* 107: 353. 2003.

Specimens examined. AUSTRALIA, Western Australia, Bunbury, Summerlea plantation of Western Australian Chip and Pulp (WACAP), E115°37', S33°40', on *E. globulus*, 1 May 2000, A. Maxwell (holotype of *M. aurantia*, PERTH 05849543, culture ex-type CBS 110500). — SOUTH AFRICA, Western Cape Province, Stellenbosch, Stellenbosch Mountain, leaves of *E. viminalis*, Oct. 1994, P.W. Crous (holotype of *M. africana*, PREM 51917, cultures ex type CPC 794–796 = CBS 116154, 116155, 680.95); Western Cape Province, Pampoenvlei, on leaves of *E. cladocalyx*, Nov. 1994, P.W. Crous (holotype of *M. ellipsoidea*, PREM 51924, cultures ex-type CPC 849–851, 850 = CBS 110843).

Notes — *Mycosphaerella ellipsoidea* and *M. aurantia* are morphologically identical, and synonymous with *Amycosphaerella africana*. *Amycosphaerella africana* was originally described from small, 1–2 mm diam, pale brown leaf spots. Subsequent collections have shown that leaf spots can be 2–10 mm diam. Furthermore, ascospores were described as fusoid-ellipsoidal, constricted at its septum, (7–)8–10(–11) × (2–)2.5–3 µm, germinating at angles to the long axis of the spore, and turn brown and distorted upon germination (Crous & Wingfield 1996), though the latter observation appears to have been incorrect. Additional collections have shown ascospores to also be up to 15 µm in length, not always constricted at septa, and in some cases germinate from polar ends with germ tubes parallel to the long axis, remain hyaline, and develop lateral branches (Maxwell et al. 2003).

Paramycosphaerella Crous, *Persoonia* 31: 245. 2013.***Paramycosphaerella intermedia*** (M.A. Dick & K. Dobbie) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807782

Basionym. *Mycosphaerella intermedia* M.A. Dick & K. Dobbie, *New Zealand J. Bot.* 39: 272. 2001.

Specimen examined. NEW ZEALAND, Bay of Plenty, Rotoehu Forest, Kohekohe Road, on living leaves of *E. saligna*, 30 June 1998, L. Renney (holotype NZFR1-M 3831, cultures ex-type NZFS 301.10 = CBS 114356, 114415).

Notes — The synonymy of *M. intermedia* with *M. marksii*, as proposed by Hunter et al. (2006), is not supported. Although morphologically similar, these two species are phylogenetically distinct, and better accommodated as two separate species in the genus *Paramycosphaerella* (Crous et al. 2013).

Paramycosphaerella marksii (Carnegie & Keane) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807783

Basionym. *Mycosphaerella marksii* Carnegie & Keane, *Mycol. Res.* 98: 414. 1994.

Specimens examined. AUSTRALIA, Victoria, Briagolong, on leaves of *E. globulus*, 14 Oct. 1994, A. Carnegie, culture CPC 935 = CBS 110920. — SOUTH AFRICA, Northern Province, Tzaneen, Magoebaskloof, on leaves of *E. grandis* × *saligna* hybrid, Oct. 1994, G. Kemp (holotype of *P. epispermogonia*, PREM 51936, cultures of a *Paramycosphaerella* sp. possibly related to the asexual morph are CPC 822 = CBS 110750, CPC 823 = CBS 110693).

Notes — *Paramycosphaerella marksii* is a common pathogen of eucalypts. However, *Pseudocercospora epispermogonia* was found only once, sporulating on the outside of spermatogonia associated with leaf spots of *Paramycosphaerella marksii* on eucalypts (Crous & Wingfield 1996). Cultures of *P. marksii*

are homothallic, and have failed to produce an asexual morph in culture, despite incubation on numerous media and under a range of growth conditions. The cultures associated with the type of *Pseudocercospora epispermogonia* were generated from ascospores of *M. marksii*. The synonymy proposed by Hunter et al. (2006) is premature, as it appears that there are no ex-type cultures of *Pseudocercospora epispermogonia*.

Phaeophleospora Rangel, *Arq. Mus. Nac. Rio de Janeiro* 18: 162. 1916

Notes — The genus *Phaeophleospora* is based on *P. eugeniae*, which occurs on leaf spots of *Eugenia uniflora* (*Myrtaceae*) in Brazil (Crous et al. 1997). For several years this genus represented species that are presently accommodated in *Teratosphaeria* (= *Kirramyces*) (Andjic et al. 2007, Crous et al. 2007a). The taxa allocated to *Phaeophleospora* here are sexual, and lack any asexual state, but are placed in *Phaeophleospora* based on phylogenetic inference.

Phaeophleospora gregaria (Carnegie & Keane) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807784

Basionym. *Mycosphaerella gregaria* Carnegie & Keane, *Mycol. Res.* 101: 843. 1997.

≡ *Mycosphaerella aggregata* Carnegie & Keane, *Mycol. Res.* 98: 415. 1994. *Nom. illegit.* (Art. 53.1).

Specimen examined. AUSTRALIA, Victoria, Nowa Nowa, on leaves of *E. grandis*, 11 Nov. 1990, A.J. Carnegie (holotype IMI 353729b, isotype VPRI 20739a, culture ex-type DAR 72368).

Phaeophleospora scytalidii (Crous & M.J. Wingf.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807785

Basionym. *Mycosphaerella scytalidii* Crous & M.J. Wingf., *Stud. Mycol.* 55: 120. 2006.

Specimen examined. COLOMBIA, Angela Maria, on leaves of *E. urophylla*, Jan. 2004, M.J. Wingfield (holotype CBS H-19696, culture ex-type CBS 118493 = CPC 10998).

Phaeophleospora stramenti (Crous & Alfenas) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807786

Basionym. *Mycosphaerella stramenti* Crous & Alfenas, *Stud. Mycol.* 55: 123. 2006.

Specimen examined. BRAZIL, Minas Gerais, Belo Oriente, on leaf litter of *Eucalyptus* sp., 24 Jan. 2004, A.C. Alfenas (holotype CBS H-19698, culture ex-type CBS 118909 = CPC 11545–11547).

Pseudocercospora eucalyptorum Crous, M.J. Wingf., Marasas & B. Sutton, *Mycol. Res.* 93: 394. 1989

= *Pseudocercospora pseudoeucalyptorum* Crous, *Stud. Mycol.* 50: 210. 2004.

Specimens examined. SOUTH AFRICA, Western Cape Province, Stellenbosch, Stellenbosch Mountain, on leaves of *E. nitens*, 21 Dec. 1987, P.W. Crous (holotype of *P. eucalyptorum*, PREM 49112, cultures ex-type CPC 16 = CBS 110777). — SPAIN, Pontevedra, Lourizán, Areeiro, on leaves of *E. globulus*, 2003, J.P. Mansilla (holotype of *P. pseudoeucalyptorum*, CBS H-9893, culture ex-type CPC 10390 = CBS 114242).

Notes — The synonymy of *P. pseudoeucalyptorum* under *P. eucalyptorum* was discussed by Crous et al. (2013), and is again confirmed in the present study, which incorporates yet more gene loci.

Xenomycosphaerella Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807787

Type species. Xenomycosphaerella elongata (Crous & M.J. Wingf.) Quaedvlieg & Crous.

Etymology. Resembling *Mycosphaerella*, but phylogenetically distinct.

Foliicolous, plant pathogenic. *Ascomata* pseudothecial, dark brown, subepidermal to erumpent, globose, with an apical ostiole; wall of 2–3 layers of medium brown *textura angularis*. *Asci* paraphysate, fasciculate, bitunicate, sessile, obovoid to broadly ellipsoidal, straight to slightly curved, 8-spored. *Ascospores* bi- to multiseriate, overlapping, hyaline, thin- or thick-walled, straight to slightly curved, fusoid-ellipsoidal with obtuse ends, widest in middle of the apical cell, medianly or unequally 1-septate, tapering towards both ends, but more prominently towards the lower end. The genus *Xenomycosphaerella* is only distinguishable from *Mycosphaerella* based on DNA sequence data. Either ITS or LSU sequence data can easily differentiate between these genera.

Notes — *Xenomycosphaerella* is morphologically a typical species of *Mycosphaerella* s.l., but is phylogenetically distinct. Presently no asexual morphs are known, and the only distinguishing characters from *Mycosphaerella* are to be found in its DNA sequences.

Xenomycosphaerella elongata (Crous & M.J. Wingf.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807788

Basionym. Mycosphaerella elongata Crous & M.J. Wingf., *Fung. Diversity* 26: 163. 2007.

Specimen examined. VENEZUELA, El Piñal Lotes farm near Acarigua, on leaves of *Eucalyptus camaldulensis* × *urophylla*, Oct. 2006, M.J. Wingfield (holotype CBS-H 19824, cultures ex-type CPC 13378 = CBS 120735, CPC 13379–13380).

Xenomycosphaerella yunnanensis (Barber & T.I. Burgess) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807789

Basionym. Mycosphaerella yunnanensis Barber & T.I. Burgess, *Fung. Diversity* 24: 150. 2007.

Specimen examined. CHINA, Yunnan, Lancang, leaves of *Eucalyptus urophylla*, May 2005, B. Dell (holotype MURU 407, culture ex-type CBS 119975 = CMW 23443).

Zasmidium Fr., *Summa Veg. Scand.*, section Post. (Stockholm): 407. 1849

Zasmidium eucalyptorum (Crous & M.J. Wingf.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807790

Basionym. Mycosphaerella eucalyptorum Crous & M.J. Wingf., *Stud. Mycol.* 55: 112. 2006.

Specimen examined. INDONESIA, on leaves of *Eucalyptus* sp., Mar. 2004, M.J. Wingfield (holotype CBS H-19689, culture ex-type CBS 118496 = CPC 11174).

Neodevriesiaceae

Neodevriesiaceae Quaedvlieg & Crous, *fam. nov.* — MycoBank MB807766

Type genus. Neodevriesia Quaedvlieg & Crous.

Ascomata when present pseudothecial, black, immersed, substomatal on leaves; wall with 2–3 layers of medium brown *textura angularis*. *Asci* paraphysate, fasciculate, bitunicate, sessile, obovoid to broadly ellipsoid, straight to slightly

curved, 8-spored. *Ascospores* tri- to multiseriate, overlapping, hyaline, non-guttulate, thick-walled, straight, fusoid-ellipsoidal with obtuse ends, medianly 1-septate; germinating ascospores on MEA become brown and verruculose. *Asexual morphs* variable, filamentous. *Conidiophores* pigmented, proliferating sympodially. *Conidia* brown, solitary or in short mostly unbranched chains, subcylindrical to narrowly fusoid-ellipsoidal or obclavate, rarely septate, solitary conidia composed of a central stalk and two lateral arms with 1–2 transverse septa.

Notes — Members of *Neodevriesiaceae* are foliicolous, saprobic or plant pathogenic, and form part of which Ruibal et al. (2009) referred to as 'Teratosphaeriaceae 2' (now *Neodevriesiaceae*), in their DNA phylogenies. Several genera await to be described in this family, pending further collections. Morphologically, *Neodevriesiaceae* is similar to *Teratosphaeriaceae*, but further sampling is needed to highlight the ecological differences between the two families.

Neodevriesia Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807768

Type species. Neodevriesia hilliana (Crous & U. Braun) Quaedvlieg & Crous.

Etymology. Named after its morphological similarity to *Devriesia*.

Hyphomycetous, foliicolous. *Conidiophores* dimorphic or not, solitary, medium brown, unbranched, smooth- and thick-walled, flexuous, septate. *Conidiogenous cells* terminal, medium brown, subcylindrical, smooth, proliferating sympodially; hila flattened, unthickened, somewhat darkened. *Ramoconidia* 0(–1)-septate if present, guttulate, subcylindrical, smooth, pale brown; hila somewhat thickened and darkened. *Conidia* medium brown, smooth, subcylindrical to narrowly fusoid-ellipsoidal or obclavate, apical conidium with obtuse apex, additional conidia with truncate ends, conidia straight to irregularly bent, mostly in unbranched chains; hila slightly darkened.

Notes — The genus *Devriesia* was introduced for a group of cladospore-like heat tolerant hyphomycetes that are soil-inhabiting, with slightly darkened, planate, unthickened conidial scars, forming chlamydospores in culture (Seifert et al. 2004). Since then, several devriesia-like species were isolated from leaf litter or leaf spots, and placed in this genus based on molecular phylogenies, pending the sampling of more taxa, that would allow resolution of this generic complex.

Ecologically, the devriesia-like species do not exhibit heat resistance and also do not form chlamydospores (other than odd hyphal swellings in older cultures), which differs from *Devriesia*. *Neodevriesia* is also distinct from *Devriesia* s.str. in that conidiophores are medium brown and unbranched (pale brown and branched in *Devriesia*), conidia are thick-walled, medium brown, rarely septate, and conidial chains are short and mostly unbranched.

Neodevriesia hilliana (Crous & U. Braun) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807771

Basionym. Devriesia hilliana Crous & U. Braun, *Stud. Mycol.* 64: 37. 2009.

Specimen examined. NEW ZEALAND, Auckland, Auckland University Campus, Princes Street, on *Macrozamia communis*, 20 Apr. 2008, C.F. Hill, holotype CBS H-20340, culture ex-type CPC 15382 = CBS 123187.

Neodevriesia xanthorrhoeae (Crous, Pascoe & Jacq. Edwards) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB808061

Basionym. Devriesia xanthorrhoeae Crous, Pascoe & Jacq. Edwards, *Persoonia* 25: 155. 2010.

Specimen examined. AUSTRALIA, Victoria, Grampians, S37°37'7.5" E142°19'32.3" on leaves of *Xanthorrhoea australis* (*Xanthorrhoeaceae*), 21 Oct. 2009, P.W. Crous, I.G. Pascoe & J. Edwards, holotype CBS-H 20500, cultures ex-type CPC 17721, 17720 = CBS 128219.

Teratosphaeriaceae

Austroafricana Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807793

Type species. *Austroafricana associata* (Crous & Carnegie) Quaedvlieg & Crous.

Etymology. Named after its occurrence in the Southern Hemisphere.

Foliicolous, plant pathogenic. *Ascomata* pseudothecial, black, subepidermal to erumpent, globose, with central apical ostiole; wall consisting of 2–3 layers of medium brown *textura angularis*. *Asci* paraphysate, but with remains of hamathecium visible, fasciculate, bitunicate, subsessile, obovoid to ellipsoidal, straight to slightly curved, 8-spored. *Ascospores* tri- to multiseriate, overlapping, hyaline, guttulate, thick-walled, straight, fusoid-ellipsoidal with obtuse ends, medianly 1-septate, tapering towards both ends, but more prominently towards the lower end; ascospores with or without persistent mucus sheath. Germinating ascospores become either verruculose, brown and distorted, or remain hyaline and undistorted.

Notes — Morphologically, *Austroafricana* resembles species of *Teratosphaeria*, and we have been unable to find characters to separate them. An ecological distinction is that species of *Austroafricana* co-colonise lesions of hosts with other ascomycetes, and have a wide host range. *Austroafricana parva*, for example, has been well documented as a pathogen of *Eucalyptus* and *Proteaceae* (Crous et al. 2008). Either ITS or LSU sequence data differentiate *Austroafricana* and *Teratosphaeria*.

Austroafricana associata (Crous & Carnegie) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807794

Basionym. *Mycosphaerella associata* Crous & Carnegie, Fung. Diversity 26: 159. 2007.

≡ *Teratosphaeria associata* (Crous & Carnegie) Crous & U. Braun, Stud. Mycol. 58: 9. 2007.

Specimen examined. AUSTRALIA, New South Wales, South Grafton, Grafton City Council Landfill Plantation, E152°54'38", S29°46'21", on leaves of *Corymbia henryii*, 16 Feb. 2006, A.J. Carnegie (holotype CBS-H 19833, isotype DAR 78031, cultures ex-type CPC 13119 = CBS 120730, CPC 13120, occurring with *Lembosina* sp.).

Austroafricana keanei (Carnegie & G.S. Pegg) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807795

Basionym. *Teratosphaeria keanei* Carnegie & G.S. Pegg, Australas. Pl. Pathol. 40: 368. 2011.

Specimen examined. AUSTRALIA, Queensland, Kingaroy, Berry's Plantation, on living leaves of *E. globulus* × *E. camaldulensis*, 14 Feb. 2004, A.J. Carnegie (holotype BRIP 52593b, culture ex-type CBS 130524).

Austroafricana parva (R.F. Park & Keane) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807796

Basionym. *Mycosphaerella parva* R.F. Park & Keane, Trans. Brit. Mycol. Soc. 79: 99. 1982.

≡ *Teratosphaeria parva* (R.F. Park & Keane) Crous & U. Braun, Stud. Mycol. 58: 10. 2007.

= *Mycosphaerella grandis* Carnegie & Keane, Mycol. Res. 98: 414. 1994.

Specimen examined. SOUTH AFRICA, Western Cape Province, Stellenbosch, on leaves of *Eucalyptus* sp., Dec. 2003, P.W. Crous, CPC 10935 = CBS 116289.

Eupeniidiella Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807797

Type species. *Eupeniidiella venezuelensis* (Crous & U. Braun) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Penidiella*.

Hyphomycetous, associated with opportunistic human infections. *Mycelium* consisting of branched, septate, smooth to finely verruculose, thin-walled, subhyaline, pale olivaceous to medium brown hyphae. *Conidiophores* solitary, erect, subcylindrical, straight to flexuous to once geniculate, septate, pale to medium olivaceous-brown or brown, thin-walled, terminally penicillate, branched portion composed of true branchlets and/or a single set or several sets of ramoconidia, branchlets; occasionally with a few additional conidiophores reduced to conidiogenous cells. *Conidiogenous cells* terminal and intercalary, unbranched, subcylindrical, medium brown, smooth to finely verruculose, with 1–3(–4) flat-tipped, loci slightly thickened and darkened-refractive loci, often subdenticulate. *Conidia* ellipsoid-ovoid, subcylindrical, pale to medium olivaceous-brown or brown, finely verruculose, in branched chains; ramoconidia 0–1(–3)-septate, with 1–3 subdenticulate apical hila; secondary conidia 0(–1)-septate, ellipsoid, obovoid to irregular, hila sometimes slightly thickened and darkened-refractive.

Notes — *Eupeniidiella* is similar to *Penidiella*, but differs in having dimorphic conidiophores, and conidiogenous loci that are subdenticulate, and slightly darkened-refractive. In contrast, they are barely darkened-refractive in *Penidiella*, and not subdenticulate.

Eupeniidiella venezuelensis (Crous & U. Braun) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807798

Basionym. *Penidiella venezuelensis* Crous & U. Braun, Stud. Mycol. 58: 24. 2007.

Specimen examined. VENEZUELA, isolated from man with tinea nigra, Jan. 1975, D. Borelli (holotype CBS H-19934, culture ex-type CBS 106.75).

Euteratosphaeria Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807799

Type species. *Euteratosphaeria verrucosiafricana* (Crous & M.J. Wingf.) Quaedvlieg & Crous.

Etymology. Named after the genus *Teratosphaeria*.

Foliicolous, plant pathogenic. *Ascomata* pseudothecial, solitary, black, immersed becoming erumpent, globose; ostiole apical, central; wall of 2–3 layers of medium brown *textura angularis*. *Asci* paraphysate, fasciculate, bitunicate, subsessile, obovoid to narrowly ellipsoid, straight or slightly incurved, 8-spored. *Ascospores* tri- to multiseriate, overlapping, hyaline, guttulate, thin-walled, straight, ellipsoid with obtuse ends, medianly 1-septate, tapering towards both ends, but more prominently towards the lower end.

Notes — *Euteratosphaeria* is morphologically similar to species of *Teratosphaeria*. The type species, *E. verrucosiafricana*, is distinct from species in *Teratosphaeria* in that ascospores turn brown and verruculose upon germination, but germinate with more than two germ tubes (which remain hyaline), and grow irregular to the long axis of the spore. More taxa need to be collected to determine if this is a feature of value at species or generic level. Colonies in culture remain sterile, have sparse aerial mycelium, and form chains of dark brown, thick-walled chlamydospores that aggregate into small microsclerotia.

Euteratosphaeria verrucosiafricana (Crous & M.J. Wingf.)
Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807800

Basionym. *Mycosphaerella verrucosiafricana* Crous & M.J. Wingf., *Stud. Mycol.* 55: 125. 2006.

Specimen examined. INDONESIA, Northern Sumatra, on leaves of *Eucalyptus* sp., Feb. 2004, *M.J. Wingfield* (holotype CBS H-19705, culture ex-type CBS 118496 = CPC 11167, CBS 118497 = CPC 11169, CBS 118498 = CPC 11170).

Myrtapendiella Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807801

Type species. *Myrtapendiella tenuiramis* (Crous & Summerell) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Penidiella* and the host plant family, *Myrtaceae*.

Hyphomycetous, foliicolous, saprobic. *Mycelium* consisting of branched, septate, smooth to slightly verruculose or warty, pale to dark brown hyphae. *Conidiophores* dimorphic. *Microconidiophores* reduced to conidiogenous cells, lateral on hyphae, with or without a basal septum. *Macroconidiophores* erect, arising as lateral branches from superficial hyphae, or as terminal ends of creeping hyphae, variable in length, pale to dark brown, smooth to finely verruculose. *Conidiogenous cells* terminal, rarely intercalary, cylindrical, tapering to a flattened apical region, finely verruculose, medium brown, paler toward the apex, with up to two conidiogenous loci, often apical, sometimes situated on small lateral shoulders, loci truncate, not denticulate; scars slightly thickened, darkened, visible as small dark circles when viewed directly from above. *Ramoconidia* subcylindrical or obovoid, 0–3-septate, base subtruncate to slightly rounded, but not coronate, pale to medium brown, finely verruculose, slightly thick-walled; hila thickened and darkened. *Conidia* in branched acropetal chains, broadly fusiform to obovoid or subcylindrical, 0–1-septate, pale to medium brown; wing-like mucoid sheaths present in some species. *Chlamydospores* globose to subovoid, dark brown, thin-walled, terminal or intercalary, mostly 1-celled, rarely septate, produced from narrow hyphae.

Notes — *Myrtapendiella* is distinguished from *Penidiella* by having dimorphic conidiophores with irregular branching patterns, septate ramoconidia, with hila that are slightly thickened and darkened. Some species of *Myrtapendiella* form chlamydospores, or have wing-like mucoid sheaths on conidia, although these do not appear to be generic features shared by all taxa. All species presently known occur on members of the *Myrtaceae*.

Myrtapendiella corymbia (Cheew. & Crous) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807802

Basionym. *Penidiella corymbia* Cheew. & Crous, *Persoonia* 23: 72. 2009.

Specimen examined. AUSTRALIA, Northern Territory, Emerald Springs, S13°37'13.3" E131°36'40", on *Corymbia foelscheana*, 22 Sept. 2007, coll. *B.A. Summerell*, isol. *P.W. Crous* (holotype CBS H-20288, culture ex-type CPC 14640 = CBS 124769, CPC 14641, 14642).

Myrtapendiella eucalypti (Cheew., K.D. Hyde & Crous)
Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807803

Basionym. *Penidiella eucalypti* Cheew., K.D. Hyde & Crous, *Persoonia* 21: 86. 2008.

Specimens examined. THAILAND, Payakpoompisai, Maharakam, on leaves of *E. camaldulensis*, July 2007, *P. Suwannawong* (holotype CBS H-20136, cultures ex-type CBS 123246 = CPC 15411, AGI064.1, AGI064.2; occurring on a lesion in association with *Harknessia* sp.); Satuk, Burirum, on leaves of *E. camaldulensis*, July 2007, *R. Cheewangkoon*, cultures CBS 123245, CPC 15449 (occurring on a lesion in association with several microfungi).

Myrtapendiella tenuiramis (Crous & Summerell) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807804

Basionym. *Penidiella tenuiramis* Crous & Summerell, *Persoonia* 23: 127. 2009.

Specimen examined. AUSTRALIA, Tasmania, Tasman Peninsula, Brown Mountain walk, S43°11'13.9" E147°51'00.8", on leaves of *E. tenuiramis*, 14 Oct. 2006, coll. *B.A. Summerell* & *P. Summerell* (holotype CBS H-20253, isol. *P.W. Crous*, cultures ex-type CPC 13692 = CBS 124993, CPC 12693, 13694).

Neocatenulostroma Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807805

Type species. *Neocatenulostroma microsporium* (Joanne E. Taylor & Crous) Quaedvlieg & Crous.

Etymology. Named after the genus *Catenulostroma*.

Plant pathogenic (foliicolous) and saprobic. *Mycelium* immersed, pale brown, septate, smooth. *Ascomata* amphigenous, immersed, substomatal, subepidermal, with small or no papilla, globose to slightly subglobose, with periphysate central ostiole. *Peridium* comprising two strata, the outer stratum of thick-walled, medium brown small-celled *textura angularis*, becoming thinner-walled and hyaline in the inner stratum. *Asci* obclavate to globose, bitunicate, sessile, narrowing to a rounded apex, 8-spored. *Ascospores* broadly fusiform, medianly 1-septate, hyaline to pale brown, smooth, eguttulate, with obtuse apices, with or without a mucilaginous sheath. *Colonies* sporodochial, pulvinate, dry, dark brown to black. *Conidiophores* macronematous, mainly straight, caespitose, closely packed, emerging through stomata forming the sporodochia, short, smooth, olivaceous-brown. *Conidiogenous cells* irregularly cylindrical, terminal, holoblastic, delimitation of conidium by a single septum, with retrogressive delimitation of next conidium, giving an unconnected chain of conidia, secession schizolytic. *Conidia* variously shaped, cylindrical, Y-shaped, ellipsoidal, straight or curved, with rounded or truncated apices, catenate in branched basipetal chains, which are schizogenous, olivaceous to red-brown, multiseptate, with transverse and often longitudinal or oblique septa.

Notes — Species of *Trimmatostroma* s.str. are genetically distinct from *Catenulostroma*. Furthermore, they are also ecologically different, in that *Trimmatostroma* includes taxa that are saprobic, and occur on dead twigs and branches, and not associated with leaf spots (Crous et al. 2007a). *Catenulostroma* presently contains several undescribed genera in the *Teratosphaeriaceae*. They share colonies that are sporodochial, pulvinate, dry, dark brown to black, giving rise to chains of multiseptate, brown conidia.

Neocatenulostroma includes species that are plant pathogenic (*N. abietis*, *N. microsporium*) or occur on rocks (*N. germanicum*). Although *N. abietis* and *N. microsporium* were considered plant pathogenic (Butin et al. 1996, Taylor & Crous 2000), *N. abietis* has since been isolated from a range of substrates, commonly as either a saprobe or endophyte in pine needles. The genus *Catenulostroma* is based on *C. protearum*, which is associated with dead leaves of *Proteaceae*, and probably is not plant pathogenic (Crous et al. 2009b). Morphologically, *Catenulostroma* s.str. contains colonies that produce muriform eu- or distoseptate conidia in branched chains. *Neocatenulostroma* on the other hand, has chains of irregularly branched conidia with transverse, longitudinal or oblique septa, variously shaped, from cylindrical to Y-shaped or ellipsoidal.

Neocatenulostroma abietis (Butin & Pehl) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807806

Basionym. *Trimmatostroma abietis* Butin & Pehl, *Antonie van Leeuwenhoek* 69: 204. 1996.

= *Catenulostroma abietis* (Butin & Pehl) Crous & U. Braun, *Stud. Mycol.* 58: 15. 2007.

Specimen examined. SWEDEN, Göteborg, isolated from outdoor painted walls, culture CBS 110038.

Neocatenulostroma germanicum (Crous & U. Braun) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807807

Basionym. *Catenulostroma germanicum* Crous & U. Braun, *Stud. Mycol.* 58: 16. 2007.

Specimen examined. GERMANY (former West-Germany), isolated from stone, Oct. 1988, *J. Kuroczkin* (holotype CBS H-19936, culture ex-type CBS 539.88).

Neocatenulostroma microsporum (Joanne E. Taylor & Crous) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807808

Basionym. *Trimmatostroma microsporum* Joanne E. Taylor & Crous, *Mycol. Res.* 104: 631. 2000.

= *Catenulostroma microsporum* (Joanne E. Taylor & Crous) Crous & U. Braun, *Stud. Mycol.* 58: 10. 2007.

= *Teratosphaeria microspora* Joanne E. Taylor & Crous, *Mycol. Res.* 104: 631. 2000.

Specimens examined. SOUTH AFRICA, Western Cape Province, Somerset West, Hilly Lands Farm, on a living leaf of a *Protea cynaroides*, 21 July 1998, *S. Denman & J.E. Taylor* (holotype of *Teratosphaeria microspora*, PREM 56207a, culture ex-type CPC 1960 = CBS 101951; holotype of *Trimmatostroma microspora*, PREM 56207b, CPC 1832 = CBS 110890).

Neohortaea Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807809

Type species. *Neohortaea acidophila* (Hölker, Bend, Pracht, Tetsch, Tob. Müll., M. Höfer & de Hoog) Quaedvlieg & Crous.

Etymology. Named after its morphological similarity to the genus *Hortaea*.

Colonies smooth, mucilaginous, black. *Mycelium* consisting of pale olivaceous, thin-walled hyphae that become dark brown with thick walls, producing copious mucus. *Conidiogenous cells* integrated on hyphae, reduced to conidiogenous loci, with several minute percurrent proliferations. *Conidia* initially subhyaline, smooth, thin-walled, ellipsoidal, becoming dark brown, broadly ellipsoid to clavate, septum median, hilum truncate with minute marginal frill; conidiation microcyclic.

Notes — Morphologically similar to *Hortaea* (*Teratosphaeriaceae*), except that the latter has prominently annellate conidiogenous loci, and conidia that develop several septa, forming chlamydospores with age (de Hoog et al. 2000, Plemenitas et al. 2008).

Neohortaea acidophila (Hölker, Bend, Pracht, Tetsch, Tob. Müll., M. Höfer & de Hoog) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807810

Basionym. *Hortaea acidophila* Hölker, Bend, Pracht, Tetsch, Tob. Müll., M. Höfer & de Hoog, *Antonie van Leeuwenhoek* 86: 293. 2004.

Specimen examined. GERMANY, Bergheim, from lignite, May 2001, *U. Hölker*, culture ex-type CBS 113389.

Neophaeothecoidea Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807811

Type species. *Neophaeothecoidea proteae* (Crous) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Phaeothecoidea*.

Hyphomycetous, saprobic. *Hyphae in vitro* creeping, brown, verruculose, branched, septate, becoming swollen, verruculose, dark brown, or forming a mucoid capsule filled with endoconidia derived from hyphal cells that turn brown and become thick-walled; end cells divide into several endoconidia, which are released upon rupture of the cell wall. *Endoconidia* medium to dark brown, verruculose to verrucose to warty, thick-walled, ellipsoid to obovoid or obclavate; after liberation swelling, becoming transversely 1-septate, or with several oblique septa, again forming endoconidia, becoming warty with age, the outer layer peels off after endoconidia are released.

Notes — *Neophaeothecoidea proteae* was initially described in *Phaeothecoidea* as it clustered close to other species of *Phaeothecoidea* s.str. However, *N. proteae* was originally isolated as a coelomycete. In culture, it grew like a yeast, and was thought to represent *Coniothyrium leucospermi* (= *Coniozyma leucospermi*; Swart et al. 1998, Taylor & Crous 2001, Marinowitz et al. 2008). Based on present data, it appears to represent a distinct genus.

Neophaeothecoidea proteae (Crous) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807812

Basionym. *Phaeothecoidea proteae* Crous, *Persoonia* 20: 71. 2008.

Specimen examined. SOUTH AFRICA, Western Cape Province, Stellenbosch, Elsenburg Farm, on leaves of *Protea repens*, 23 July 1999, *S. Denman* (holotype CBS H-20092, cultures ex-type CPC 2828–2830, 2831 = CBS 114129).

Neotrimmatostroma Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807813

Type species. *Neotrimmatostroma excentricum* (B. Sutton & Ganap.) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Trimmatostroma*.

Follicolous, plant pathogenic. *Ascomata* pseudothecial, separate, dark brown, subepidermal, becoming erumpent, globose; ostiole apical, central, frequently opening by irregular rupture; wall of 2–3 layers of dark brown, thick-walled *textura angularis*. *Asci* fasciculate, bitunicate, paraphysate (remains of the hamathecium observed in some ascomata), 8-spored, obovoid to broadly ellipsoidal, straight to slightly incurved. *Ascospores* tri- to multiseriate, fusoid-ellipsoidal with obtuse ends, hyaline, smooth, pale brown and verruculose in old asci, becoming 3-septate, not constricted at median septum, thick-walled, guttulate, widest in the middle of the apical cell, with persistent mucous sheath. *Conidiomata* sporodochial, at times concentrically arranged, dark brown to black, dry, powdery, confined to the lesions. *Conidiophores* branched at base, pale brown, smooth, loosely aggregated, pale brown. *Conidiogenous cells* terminal, cylindrical to doliiform, holothallic, pale brown. *Conidia* formed in basipetal chains, smooth, medium brown, 4-celled, consisting of two basal cells with truncate lateral sides (adhesion scars present when catenulate), each giving rise to a secondary globose apical cell, that may extend and develop two additional septa; septa dark brown and thick-walled between the primary and secondary cells.

Notes — *Neotrimmatostroma* is distinguished from *Teratosphaeria* in that its ascospores become brown and up to 3-septate in older asci, have a persistent mucoid sheath, and frequently have remnants of the hamathecium in the ascomatal cavity. The asexual morph is distinguished from *Trimmatostroma* in that it is plant pathogenic, and conidiogenous cells give rise to 4-celled conidia with two basal cells that have truncate lateral sides and two globose apical cells, separated by dark brown, thick-walled septa. Although there are presently no

cultures available of *Trimmatostroma bifarium*, which is also pathogenic to *Eucalyptus*, the latter fungus is clearly congeneric with *N. excentricum*.

Neotrimmatostroma bifarium (Gadgil & M.A. Dick) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807814

Basionym. *Trimmatostroma bifarium* Gadgil & M.A. Dick, New Zealand J. Bot. 21: 49. 1983.

Description and illustration — Gadgil & Dick 1983, Park et al. 2000.

Specimen examined. NEW ZEALAND, Kinleith, on leaves of *E. regnans*, Sept. 1981, D.J. Rawcliffe (holotype NZFRI, isotype PDD 42845).

Neotrimmatostroma excentricum (B. Sutton & Ganap.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807815

Basionym. *Trimmatostroma excentricum* B. Sutton & Ganap., New Zealand J. Bot. 16: 529. 1978.

≡ *Catenulostroma excentricum* (B. Sutton & Ganap.) Crous & U. Braun, Stud. Mycol. 58: 10. 2007.

= *Mycosphaerella excentrica* Crous & Carnegie, Fung. Diversity 26: 164. 2007.

≡ *Teratosphaeria excentrica* (Crous & Carnegie) Crous & U. Braun, Stud. Mycol. 58: 10. 2007.

Description and illustration — Sutton & Ganapathi 1978, Crous et al. 2007c.

Specimen examined. AUSTRALIA, New South Wales, Mackenzie Creek Road, Kempsey, Byrne Plantation, E152°27'47" S30°53'15", on leaf spots of *E. agglomerata*, 13 Apr. 2005, G. Price (holotype of sexual morph CBS H-19829, isotype DAR 78033, culture ex-type CPC 13092 = CBS 121102).

Apenidiella Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807816

Type species. *Apenidiella strumelloidea* (Milko & Dunaev) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Penidiella*.

Hyphomycetous, saprobic. *Mycelium* consisting of branched, septate, smooth, hyaline to pale olivaceous, hyphae, sometimes constricted at dark septa. *Conidiophores* solitary, erect, arising from superficial mycelium, reduced to conidiogenous cells or macronematous, subcylindrical, straight to slightly curved, sometimes attenuated towards the apex, septate, medium brown, smooth, apex with a terminal conidiogenous cell giving rise to a single set of ramoconidia. *Conidiogenous cells* terminal, integrated, subcylindrical, straight, pale brown, thin-walled, smooth, apex obtusely rounded to somewhat clavate; loci terminal, occasionally subterminal or lateral, unthickened to slightly thickened and darkened, not refractive. *Conidia* in branched chains; ramoconidia subcylindrical, with 1–3 terminal loci, olivaceous-brown, smooth; secondary conidia ellipsoidal, with one side straight and the other convex, straight to slightly curved, subhyaline to olivaceous-brown, smooth, thin-walled; hila unthickened to slightly thickened and darkened, not refractive.

Notes — *Apenidiella* is distinct from *Penidiella* in that conidiophores end with a solitary conidiogenous cell that gives rise to a single set of ramoconidia (thus not penicillate with branches as in *Penidiella* s.str.). Ramoconidia and conidia are aseptate, smooth and thin-walled, subhyaline to olivaceous-brown. Nosrati et al. (2010) reported this fungus to be pathogenic to greenhouse cucumbers in Iran. However, based on their illustrations, they appear to have been working with a species of *Cladosporium* (brown conidia with darkened, thickened, refractive scars; see Bensch et al. 2012).

Apenidiella strumelloidea (Milko & Dunaev) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807817

Basionym. *Cladosporium strumelloideum* Milko & Dunaev, Novosti Sist. Nizsh. Rast. 23: 134. 1986.

≡ *Penidiella strumelloidea* (Milko & Dunaev) Crous & U. Braun, Stud. Mycol. 58: 23. 2007.

Specimen examined. RUSSIA, Yaroslavl Region, Rybinsk Reservoir, mouth of Sutka River, isolated from leaf of *Carex* sp. (*Cyperaceae*), from stagnant water, S. Ozerskaya (holotype BKMF-2534, culture ex-type CBS 114484).

Parateratosphaeria Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807818

Type species. *Parateratosphaeria bellula* (Crous & M.J. Wingf.) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Teratosphaeria*.

Foliicolous, plant pathogenic. *Ascomata* amphigenous, immersed, substomatal, black, singular, gregarious; pyriform or globose, with a non-periphysate to periphysate papillate ostiole, becoming erumpent through the stomatal pore. *Peridium* with 3–4 layers of compressed *textura angularis* that comprise an outer stratum of dark brown thick-walled cells with large lumina that become hyaline and thin-walled in the inner stratum. *Paraphyses* absent. *Asci* obclavate to cylindrical, pedicel short, straight, tapering to a narrow rounded apex with an indistinct ocular chamber, 8-spored, bitunicate with fissitunicate dehiscence. *Ascospores* overlapping bi- to multiseriate, 1-septate, fusiform to ellipsoidal, with obtuse ends, straight, hyaline, guttulate, surrounded by an inconspicuous mucilaginous sheath. Germinating ascospores become brown and verruculose.

Notes — *Parateratosphaeria* is morphologically indistinguishable from *Teratosphaeria*. Ascospores turn brown and verruculose during germination and some species also have a mucoid sheath, though these features also occur in some taxa of *Teratosphaeria* s.str. The genus *Parateratosphaeria* is only distinguishable from *Teratosphaeria* based on DNA sequence data. Either ITS or LSU sequence data differentiates these genera.

Parateratosphaeria altensteinii (Crous) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807819

Basionym. *Teratosphaeria altensteinii* Crous, Persoonia 21: 139. 2008.

Specimen examined. SOUTH AFRICA, Western Cape Province, Kirstenbosch Botanical Garden, on living leaves of *Encephalartos altensteinii*, 6 Jan. 2008, P.W. Crous, M.K. Crous, M. Crous & K. Raath (holotype CBS H-20162, culture ex-type CPC 15133 = CBS 123539, CPC 15134–15135).

Parateratosphaeria bellula (Crous & M.J. Wingf.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807820

Basionym. *Mycosphaerella bellula* Crous & M.J. Wingf., Mycotaxon 46: 20. 1993.

≡ *Teratosphaeria bellula* (Crous & M.J. Wingf.) Crous & U. Braun, Stud. Mycol. 58: 10. 2007.

Specimen examined. SOUTH AFRICA, Western Cape Province, Stellenbosch, J.S. Marais Botanical Garden, on leaves of *Protea eximia*, Apr. 1998, J.E. Taylor (epitype CBS H-20094, culture ex-epitype CPC 1821 = CBS 111700).

Parateratosphaeria karinae (Crous) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807821

Basionym. *Teratosphaeria karinae* Crous, Persoonia 26: 80. 2011.

Specimen examined. SOUTH AFRICA, Western Cape Province, Hermanus, Fernkloof Nature Reserve, S34°23'38" E19°16'9.7", on leaf bracts of *Phae-nocoma prolifera*, 2 May 2010, K.L. Crous & P.W. Crous (holotype CBS H-20534, cultures ex-type CPC 18256, 18255 = CBS 128774).

***Parateratosphaeria marasasii* (Crous) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807822

Basionym. *Teratosphaeria marasasii* Crous, *Persoonia* 20: 79. 2008.

Specimen examined. SOUTH AFRICA, Western Cape Province, Kirstenbosch Botanical Garden, on living leaves of *Protea* sp., 6 Jan. 2008, P.W. Crous & M. Crous (holotype CBS H-20105, cultures ex-type CBS 122899 = CPC 14889, CPC 14890, 14891; on leaf spots in association with *Coleroa senriana*).

***Parateratosphaeria persoonii* (Crous & L. Mostert) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807823

Basionym. *Teratosphaeria persoonii* Crous & L. Mostert, *Persoonia* 20: 80. 2008.

Specimen examined. SOUTH AFRICA, Western Cape Province, Jonkershoek, S33°59'4.2" E18°57'16.1", on living leaves of *Protea* sp., 1 Apr. 2007, P.W. Crous & L. Mostert (holotype CBS H-20102, cultures ex-type CPC 13972 = CBS 122895, CPC 13973, 13974; on leaf spots in association with *T. jonkershoekensis* = *Xenoteratosphaeria jonkershoekensis*).

***Pseudoteratosphaeria* Quaedvlieg & Crous, gen. nov.** — MycoBank MB807824

Type species. *Pseudoteratosphaeria perpendicularis* (Crous & M.J. Wingf.) Quaedvlieg & Crous.

Etymology. Named after its morphological similarity to the genus *Teratosphaeria*.

Foliicolous, plant pathogenic or saprobic. *Ascomata* pseudothecial, epiphyllous, single, black, subepidermal, globose; ostiole central, apical; wall of 2–3 layers of medium brown *textura angularis*. *Asci* aparaphysate, fasciculate, bitunicate, subsessile, obovoid to broadly ellipsoid, slightly incurved, 8-spored. *Ascospores* multiseriate, overlapping, hyaline, guttulate, thin-walled, straight, fusoid-ellipsoidal, ellipsoidal or obovoid with obtuse ends, medianly 1-septate, widest in the middle of the apical cell, constricted at the septum, tapering towards both ends, but more prominently towards the lower end.

Notes — *Pseudoteratosphaeria* is morphologically similar to species of *Teratosphaeria* and can only be distinguished based on DNA phylogeny. No asexual morphs are presently known for *Pseudoteratosphaeria*. Either ITS or LSU sequence data differentiates these genera.

***Pseudoteratosphaeria flexuosa* (Crous & M.J. Wingf.) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807825

Basionym. *Mycosphaerella flexuosa* Crous & M.J. Wingf., *Mycol. Mem.* 21: 58. 1998.

≡ *Teratosphaeria flexuosa* (Crous & M.J. Wingf.) Crous & U. Braun, *Stud. Mycol.* 58: 10. 2007.

Specimen examined. COLOMBIA, La Selva, leaves of *E. globulus*, May 1995, M.J. Wingfield (holotype PREM 54401, cultures ex-type STE-U 1107–1109 = CBS 111012).

***Pseudoteratosphaeria gamsii* (Crous) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807826

Basionym. *Mycosphaerella gamsii* Crous, *Stud. Mycol.* 55: 113. 2006.

≡ *Teratosphaeria gamsii* (Crous) Crous & U. Braun, *Stud. Mycol.* 58: 10. 2007.

Specimen examined. INDIA, Palampur, on leaves of *Eucalyptus* sp., Mar. 2004, W. Gams & M. Arzanlou (holotype CBS H-19690, culture ex-type CBS 118495 = CPC 11138–11140).

***Pseudoteratosphaeria ohnowa* (Crous & M.J. Wingf.) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807827

Basionym. *Mycosphaerella ohnowa* Crous & M.J. Wingf., *Stud. Mycol.* 50: 206. 2004.

≡ *Teratosphaeria ohnowa* (Crous & M.J. Wingf.) Crous & U. Braun, *Stud. Mycol.* 58: 10. 2007.

Specimen examined. SOUTH AFRICA, Mpumalanga, Hazy View, on leaves of *E. grandis*, 27 Mar. 1995, M.J. Wingfield (holotype PREM 51912, cultures ex-type CPC 1004 = CBS 112896, CPC 1005 = CBS 112973, CPC 1006 = CBS 110949).

***Pseudoteratosphaeria perpendicularis* (Crous & M.J. Wingf.) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807828

Basionym. *Mycosphaerella perpendicularis* Crous & M.J. Wingf., *Stud. Mycol.* 55: 113. 2006.

≡ *Teratosphaeria perpendicularis* (Crous & M.J. Wingf.) Crous & U. Braun, *Stud. Mycol.* 58: 10. 2007.

Specimen examined. COLOMBIA, Suiza, on leaves of *Eucalyptus eurograndis*, Jan. 2004, M.J. Wingfield (holotype CBS H-19691, cultures ex-type CBS 118367 = CPC 10983–10985).

***Pseudoteratosphaeria secundaria* (Crous & Alfenas) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807829

Basionym. *Mycosphaerella secundaria* Crous & Alfenas, *Stud. Mycol.* 55: 122. 2006.

≡ *Teratosphaeria secundaria* (Crous & Alfenas) Crous & U. Braun, *Stud. Mycol.* 58: 11. 2007.

Specimen examined. BRAZIL, Bahia, Teixeira de Freitas, on leaves of *Eucalyptus* sp., 8 June 2004, A.C. Alfenas (holotype CBS H-19697, culture ex-type CBS 118507 = CPC 11551–11553).

***Pseudoteratosphaeria stramenticola* (Crous & Alfenas) Quaedvlieg & Crous, comb. nov.** — MycoBank MB807830

Basionym. *Mycosphaerella stramenticola* Crous & Alfenas, *Stud. Mycol.* 55: 123. 2006.

≡ *Teratosphaeria stramenticola* (Crous & Alfenas) Crous & U. Braun, *Stud. Mycol.* 58: 11. 2007.

= *Mycosphaerella parkiiaffinis* Crous & M.J. Wingf., *Fung. Diversity* 26: 168. 2007.

≡ *Teratosphaeria parkiiaffinis* (Crous & M.J. Wingf.) Crous & U. Braun, *Stud. Mycol.* 58: 10. 2007.

Specimens examined. BRAZIL, Bahia, Eunapolis, on leaf litter of *Eucalyptus* sp., 23 May 2004, A.C. Alfenas (holotype of *M. stramenticola*, CBS H-19699, cultures ex-type CBS 118506 = CPC 11438–11440). – VENEZUELA, near Acari-gua, on leaves of *Eucalyptus urophylla*, Oct. 2006, M.J. Wingfield (holotype of *M. parkiiaffinis*, CBS H-19823, cultures ex-type CPC 13373 = CBS 120737, CPC 13374).

Notes — *Pseudoteratosphaeria stramenticola* was isolated from leaf litter of a *Eucalyptus* sp. in Brazil (Crous et al. 2006). *Ascospores* were fusoid-ellipsoidal, (8–)9–10(–11) × 3(–3.5) µm. In contrast, *Mycosphaerella parkiiaffinis* was associated with well-defined leaf spots of *E. urophylla* in Venezuela, and its *ascospores* were fusoid-ellipsoidal, (8–)9–10 × 3(–3.5) µm (Crous et al. 2007c). These two species are also identical based on their DNA phylogeny, which provides further evidence that some of these pathogens are endophytes.

***Queenslandipendiella* Quaedvlieg & Crous, gen. nov.** — MycoBank MB807831

Type species. *Queenslandipendiella kurandae* (Crous & J.K. Stone) Quaedvlieg & Crous.

Etymology. Named after its occurrence in Queensland, Australia, and morphological similarity to the genus *Pendiella*.

Hyphomycetous. *Mycelium* consisting of smooth, brown, thick-walled, branched, hyphae. *Conidiophores* macronematous,

erect, arising from superficial hyphae, branching penicillate, septate. *Conidiogenous apparatus* consisting of several sets of branches; primary branches subcylindrical, brown, smooth, 0–1-septate, giving rise to 1–2 conidiogenous cells or secondary branches; secondary branches 0–1-septate. *Conidiogenous cells* doliform to subcylindrical, brown, smooth, with 1–2 apical scars that are flattened, not darkened, refractive nor thickened. *Ramoconidia* brown, smooth, with 2–3 apical loci, narrowly ellipsoidal to subcylindrical. *Conidia* occurring in short chains, brown, smooth, ellipsoidal, apex obtuse, base subtruncate with or without a flattened inconspicuous hilum.

Notes — *Queenslandipendiella* was placed in *Penidiella* based on having penicillate conidiophores that produce brown conidia with inconspicuous hila, as well as phylogenetic placement in the *Teratosphaeriaceae* (Crous et al. 2007c). Ecologically it is very interesting, as it colonises the exudates of bleeding cankers that are common on many of the trees lining a rainforest walking trail at Kuranda in northern Queensland. Whether it is the cause of the cankers, or simply a secondary invader on the exudates, remains unknown. *Queenslandipendiella* can be distinguished from *Penidiella* s.str. by its well defined penicillate conidiophores, with clear branching structure, which is less apparent in species of *Penidiella* s.str. (Crous et al. 2007a, c).

Queenslandipendiella kurandae (Crous & J.K. Stone)
Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807832

Basionym. *Penidiella kurandae* Crous & J.K. Stone, Fungal Planet 16. 2007.

Specimens examined. AUSTRALIA, Queensland, Cairns, Kuranda, Kuranda walking trail, S16°49'24.6" E145°38'2.6", from exudates of stem cankers on unidentified rainforest tree, 30 Aug. 2006, P.W. Crous & J.K. Stone (holotype CBS H-19932, culture ex-type CPC 13333 = CBS 121715, CPC 13334; ditto, S16°49'29" E145°38'28.6", paratype CBS H-19924, CPC 13335).

Readeriella Syd. & P. Syd., Ann. Mycol. 6, 5: 484. 1908

Readeriella deanei Quaedvlieg, Summerell & Crous, *sp. nov.*
— MycoBank MB807833; Fig. 7

Etymology. Name refers to the host from which it was isolated, *Eucalyptus deanei*.

Description on OA. *Conidiomata* pycnidial, brown, globose to subglobose, up to 250 µm diam; wall consisting of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells, or with a supporting cell. *Conidiogenous cells* discrete, doliform to ampulliform, pale brown, finely verruculose, proliferating several times percurrently near apex, 5–8 × 4–6 µm. *Conidia* solitary, aseptate, ellipsoid to limoniform, tapering towards a bluntly rounded, subobtuse, thickened apex, base subtruncate and thickened, hyaline becoming medium to golden brown, finely verruculose, (8–)9–10(–11) × 4(–5) µm.

Culture characteristics — Colonies erumpent, spreading, with lobate, feathery margins and sparse aerial mycelium on OA and PDA; fluffy to woolly on MEA, 5 cm diam after 2 wk. On MEA surface olivaceous-grey, reverse iron-grey. On PDA and OA, surface and reverse iron-grey.

Specimen examined. AUSTRALIA, New South Wales, Wollemi National Park, on leaves of *Eucalyptus deanei*, 9 Feb. 2006, B. Summerell (holotype CBS H-21136, culture ex-type CPC 12715 = CBS 134746).

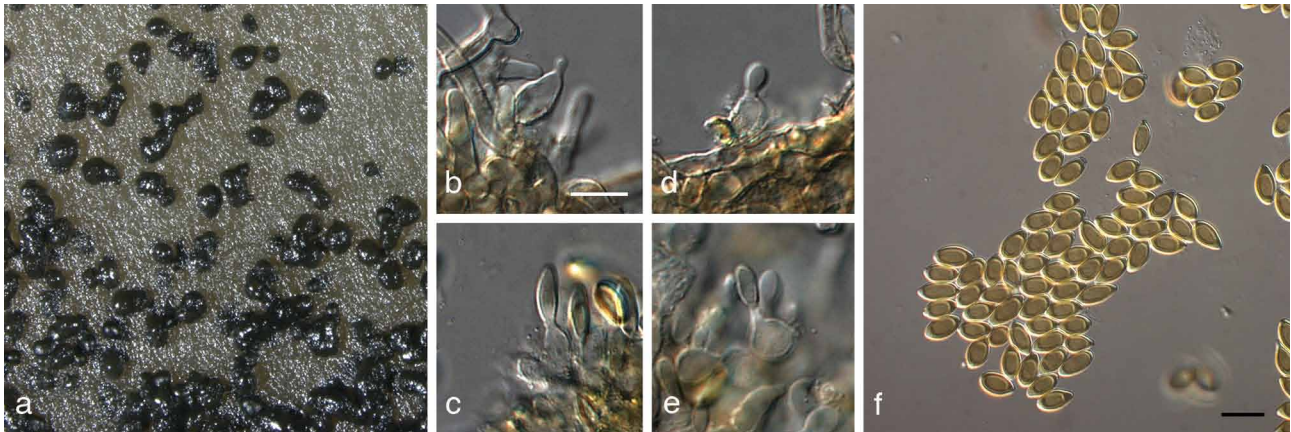


Fig. 7 *Readeriella deanei* (CPC 12715). a. Colony sporulating on OA; b–e. conidiogenous cells with percurrent proliferation; f. conidia. — Scale bars = 10 µm.

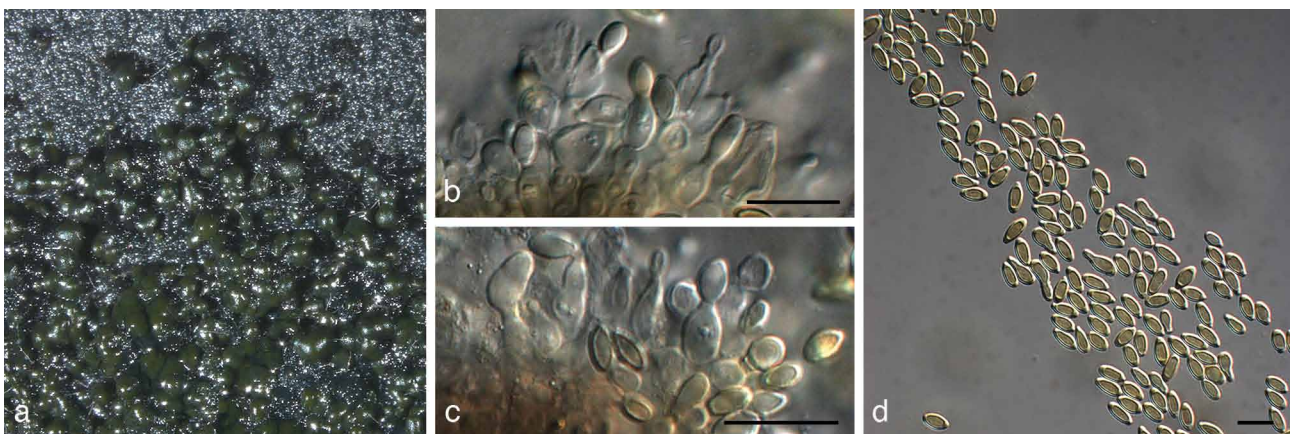


Fig. 8 *Readeriella limoniforma* (CPC 12727). a. Colony sporulating on PDA; b, c. conidiogenous cells with percurrent proliferation; d. conidia. — Scale bars = 10 µm.

Notes — Morphologically similar to *R. readeriellophora* (conidiomata up to 130 µm diam, conidiogenous cells 8–15 × 3–4 µm, conidia (5–)6–7(–9) × (3–)4(–4.5) µm; Crous et al. 2004b). However, conidiomata of *R. deanei* are larger, conidiogenous cells wider and conidia longer and wider.

Readeriella limoniforma Quaedvlieg, Summerell & Crous, *sp. nov.* — MycoBank MB807834; Fig. 8

Etymology. Name refers to its conidia, which are characteristically limoniform in shape.

Description on OA. *Conidiomata* pycnidial, brown, globose to subglobose, up to 150 µm diam, ostiole central, up to 60 µm diam; wall consisting of 2–3 layers of brown *textura angularis*. *Conidiophores* reduced to conidiogenous cells. *Conidiogenous cells* discrete, doliform to subcylindrical, hyaline to pale brown, smooth to finely verruculose, monophialidic, proliferating several times percurrently near apex, 5–8 × 3–4 µm. *Conidia* solitary, aseptate, ellipsoid to limoniform, tapering towards a bluntly rounded, subobtuse, thickened apex, base subtruncate, hyaline becoming medium to golden brown, finely verruculose, (6–)7–8(–10) × 3(–4) µm.

Culture characteristics — Colonies erumpent, spreading, with lobate, feathery margins and moderate to fluffy aerial mycelium, reaching 4 cm diam after 2 wk. On MEA surface smoke-grey, outer region purplish grey, reverse fuscous-black. On PDA surface iron-grey, and pale olivaceous-grey in centre; reverse iron-grey.

Specimen examined. AUSTRALIA, New South Wales, Wollemi National Park, on leaves of *Eucalyptus* sp., 9 Feb. 2006, B. Summerell (holotype CBS H-21135, cultures ex-type CPC 12727–12729 = CBS 134745).

Notes — Morphologically *R. limoniforma* is similar to *R. callista* (conidia ellipsoid to fusoid, 7–11 × 3–5.5 µm; Crous et al. 2009d), but conidia are more limoniform in shape and slightly wider than those of *R. callista*.

Readeriella mirabiliaffinis Quaedvlieg, Summerell & Crous, *sp. nov.* — MycoBank MB807835; Fig. 9

Etymology. Name refers to its similarity to *R. mirabilis*.

Description on OA. *Conidiomata* pycnidial, brown, globose, up to 300 µm diam; wall consisting of 2–3 layers of brown *textura angularis*. *Conidiophores* 0–1-septate, pale brown, finely verruculose, ampulliform to doliform, 10–20 × 4–6 µm. *Conidiogenous cells* pale brown, finely verruculose, ampulliform to doliform, proliferating several times percurrently near apex, mono- or polyphialidic, 8–10 × 4–6 µm. *Conidia* solitary, medium brown, aseptate, smooth, granular, base truncate, with three apical, lateral, obtuse projections, deltoid, thick-walled, with darker pigmentation in the lateral projections, but with more prominent constriction between the projections and the base, (9–)10–11(–12) µm long, (8–)9–10(–11) µm wide at apex.

Culture characteristics — Colonies spreading, erumpent with lobate, feathery margins and moderate aerial mycelium. On OA, MEA and PDA surface olivaceous-grey with patches of pale olivaceous-grey; reverse iron-grey; after 2 wk reaching 55 mm diam.

Specimen examined. AUSTRALIA, Tasmania, Tasman Peninsula, Brown Mountain walk, S43°11'13.9" E147°50'50.7", on leaves of *E. delegatensis*, 14 Oct. 2006, P. Summerell & B. Summerell (holotype CBS H-21134, culture ex-type CPC 13611 = CBS 134744).

Notes — Morphologically similar to *R. mirabilis* (conidia (7–)9–10(–11) µm long, (7–)8–9(–10) µm wide at apex), although the conidia of *R. mirabiliaffinis* are larger.

Suberoteratosphaeria Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807836

Type species. *Suberoteratosphaeria suberosa* (Crous, F.A. Ferreira, Alfenas & M.J. Wingf.) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Teratosphaeria* and association with corky leaf spots.

Foliicolous and caulicolous, plant pathogenic. *Ascomata* pseudothecial, solitary or aggregated, black, superficial to subepidermal, globose, glabrous; ostiole apical, central, papillate, lined with periphyses; wall of 3–4 layers of medium brown *textura angularis*, subhymenium of 3–5 layers of hyaline cells. *Asci* fasciculate, bitunicate, paraphysate, sessile, 8-spored, ellipsoid to obclavate, straight or curved. *Ascospores* bi- to triseriate or irregularly arranged, oblique, overlapping, straight

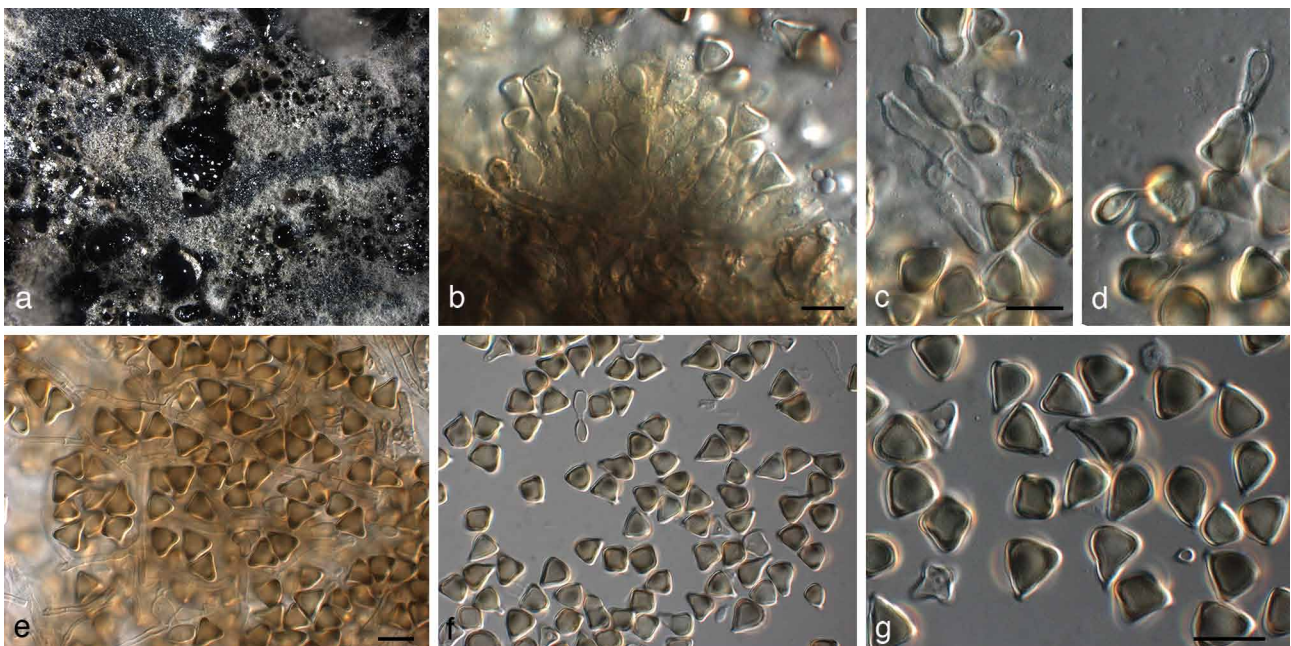


Fig. 9 *Readeriella mirabiliaffinis* (CPC 13611). a. Colony sporulating on PDA; c, e, g. conidiogenous cells with percurrent proliferation; b, d, f. conidia. — Scale bars = 10 µm.

ellipsoidal, obtuse at each end, hyaline to pale brown, smooth, 1-septate, guttulate, with or without mucoid sheath. Germinating ascospores become brown and verruculose.

Notes — *Suberoteratosphaeria* is plant pathogenic, associated with corky leaf spots, but also on stems and leaf petioles. The genus has ascospores that are hyaline to pale brown (as found in several species of *Teratosphaeria* s.str.). *Suberoteratosphaeria* is distinguished from *Teratosphaeria* by its corky lesions, and less so by ascospores that become brown, verruculose and germinate by two or multiple germ tubes.

***Suberoteratosphaeria pseudosuberosa* (Crous & M.J. Wingf.) Quaedvlieg & Crous, comb. nov. — MycoBank MB807838**

Basionym. *Mycosphaerella pseudosuberosa* Crous & M.J. Wingf., Stud. Mycol. 55: 118. 2006.

≡ *Teratosphaeria pseudosuberosa* (Crous & M.J. Wingf.) Crous & U. Braun, Stud. Mycol. 58: 11. 2007.

Specimen examined. URUGUAY, on leaves and petioles of *Eucalyptus* sp., Apr. 2005, M.J. Wingfield (holotype CBS H-19695, culture ex-type CBS 118911 = CPC 12085).

***Suberoteratosphaeria suberosa* (Crous, F.A. Ferreira, Alfenas & M.J. Wingf.) Quaedvlieg & Crous, comb. nov. — MycoBank MB807839**

Basionym. *Mycosphaerella suberosa* Crous, F.A. Ferreira, Alfenas & M.J. Wingf., Mycologia 85, 4: 707. 1993.

≡ *Teratosphaeria suberosa* (Crous, F.A. Ferreira, Alfenas & M.J. Wingf.) Crous & U. Braun, Stud. Mycol. 58: 11. 2007.

Specimen examined. BRAZIL, Espírito Santo, Santa Catarina, on leaves of *E. dunnii*, Aug. 1992, M.J. Wingfield (holotype PREM 51082, culture ex type CPC 515 = CBS 436.92).

***Suberoteratosphaeria xenosuberosa* Quaedvlieg, Carnegie & Crous, sp. nov. — MycoBank MB807840; Fig. 10**

Etymology. Name refers to its similarity to *Suberoteratosphaeria suberosa*.

Leaf spots similar to those reported for *T. suberosa*, corky, and erumpent. Description on PDA (homothallic). *Ascomata* black, erumpent, punctiform, globose, up to 150 µm diam; apical ostiole 10–15 µm diam; wall consisting of 2–3 layers of medium brown *textura angularis*. *Asci* obovoid to broadly ellipsoid, aparaphysate, fasciculate, subsessile, bitunicate, 8-spored, straight to slightly incurved, 50–75 × 10–12 µm. *Ascospores* bi- to triseriate, hyaline, ellipsoidal with rounded ends, medianly 1-septate, constricted at the septum, straight to slightly curved, guttulate, thick-walled, widest in middle of apical cell, (10–)11–13(–15) × (4–)4.5(–5) µm. *Ascospores* brown and verruculose at germination.

Culture characteristics — Colonies spreading, erumpent, with sparse aerial mycelium and feathery margins, reaching 15 mm diam after 2 mo on PDA; surface olivaceous-grey, reverse iron-grey.

Specimen examined. AUSTRALIA, Queensland, Coolabunia Plantation, Kingaroy, on *E. mollucana*, 14 Feb. 2004, A.J. Carnegie (holotype CBS H-21138, culture ex-type CPC 13093 = CBS 134747 = NSW 005175).

Notes — *Teratosphaeria xenosuberosa* was originally identified as *T. suberosa* based on the similar corky leaf spots it induces on *E. mollucana*. Although the specimen was lost, the fungus can be described morphologically, as it is homothallic and sporulates in culture. *Teratosphaeria xenosuberosa* is distinguished from *T. suberosa* (ascospores 10–)12–16(–17) × (3–)3.5–5(–6) µm (Crous et al. 1993) by a mean ascospore length that is shorter than found in *T. suberosa*.

***Teratosphaeria molleriana* (Thüm.) Crous & U. Braun, Stud. Mycol. 58: 10. 2007**

Basionym. *Sphaerella molleriana* Thüm., Revista Inst. Sci. Lit. Coimbra 28: 31. 1881.

Mycosphaerella molleriana (Thüm) Lindau, Nat. Pflanzenfam. 1: 424. 1897.

= *Colletogloeopsis molleriana* Crous & M.J. Wingf., Canad. J. Bot. 75: 670. 1997.

Readeriella molleriana (Crous & M.J. Wingf.) Crous & U. Braun, Stud. Mycol. 58: 10. 2007.

= *Mycosphaerella vespa* Carnegie & Keane, Mycol. Res. 102: 1275. 1998.

= *Mycosphaerella ambiphylia* A. Maxwell, Mycol. Res. 107: 354. 2003.

= *Teratosphaeria xenocryptica* Crous & M.J. Wingf., Persoonia 23: 139. 2009.

Specimens examined. AUSTRALIA, Tasmania, on leaves of *E. globulus*, BOT 2823 = CBS 117924 (identified as *M. vespa*); Western Australia, Manjimup, Boorara plantation of WACAP, E116°10' S34°45', on *E. globulus*, 16 Feb. 2000, A. Maxwell (holotype of *M. ambiphylia*, PERTH 05849608, culture ex-type CBS 110499). — CHILE, on leaves of *Eucalyptus* sp., 1994, M.J. Wingfield (holotype of *T. xenocryptica* deposited at PREM, culture ex-type CPC 355 = CBS 122905). — PORTUGAL, Lisbon, N40°00'39" W8°36'2.3", 77 m, on leaves of *Eucalyptus* sp., 13 Oct. 2006, P.W. Crous & A.J.L. Phillips (epitype of *T. molleriana*, CBS H-19826, cultures ex-epitype CPC 13398 = CBS 120746, CPC 13399–13400).

Notes — Hunter et al. (2006) reduced *M. vespa* and *M. ambiphylia* to synonymy under *M. molleriana* (= *Teratosphaeria*). Based on the multigene data generated here, *T. xenocryptica* (Wingfield et al. 1995, Crous et al. 2009b) also falls within the variation observed in *T. molleriana*.

***Teratosphaericola* Quaedvlieg & Crous, gen. nov. — MycoBank MB807841**

Type species. *Teratosphaericola pseudoafricana* (Crous & T.A. Cout.) Quaedvlieg & Crous.

Etymology. Named after its similarity to the genus *Teratosphaeria*.

Follicolous, plant pathogenic. *Ascomata* pseudothecial, solitary, black, immersed becoming erumpent, globose; ostiole apical, central; wall of 2–3 cell layers of medium brown *textura angularis*. *Asci* aparaphysate, fasciculate, bitunicate, subsessile, narrowly ellipsoid to subcylindrical, slightly incurved, 8-spored.



Fig. 10 *Suberoteratosphaeria xenosuberosa* (CPC 13093). a. Colony sporulating on PDA; b. broken asci; c. ascospores. — Scale bars = 10 µm.

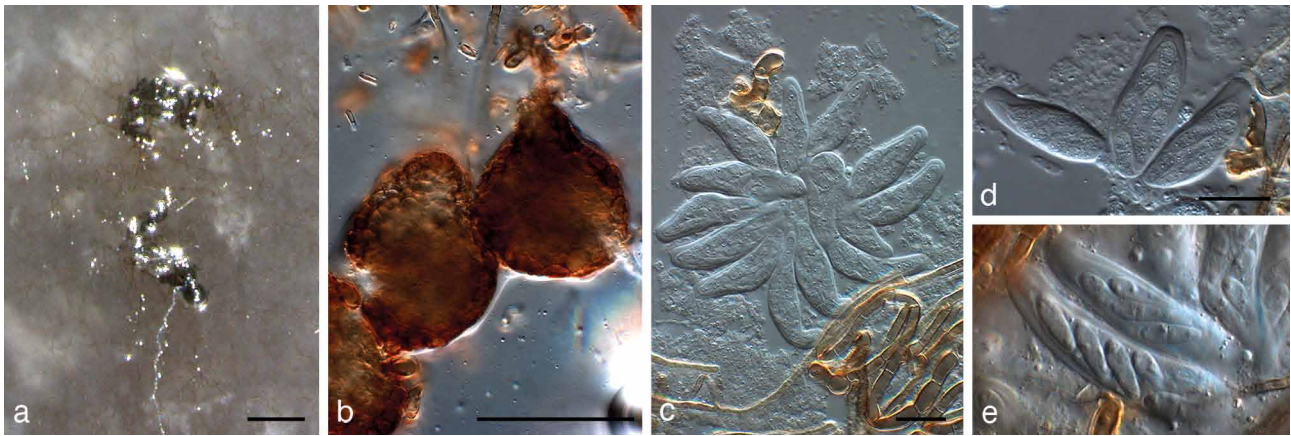


Fig. 11 *Teratosphaeriopsis pseudoafricana* (CBS 111171). a. Colony sporulating on PDA; b, c. ascomata; c–e. asci with ascospores. — Scale bars: a = 250 µm; b = 120 µm; c–e = 10 µm; d applies to e.

Ascospores tri- to multiseriate, overlapping, hyaline to pale brown, guttulate, thin-walled, straight to slightly curved, smooth to finely roughened, fusoid-ellipsoidal with subobtuse ends, medianly 1-septate. *Spermatogonia* similar to the ascomata in morphology. *Spermatia* hyaline, smooth, rod-shaped with rounded ends.

Notes — *Teratosphaericola* is similar to *Teratosphaeria* in morphology, and can only be distinguished based on DNA phylogeny. Ascospores become darkened and verruculose at germination, but this is also known for several species of *Teratosphaeria*. Either ITS or LSU sequence data differentiate these genera.

***Teratosphaericola pseudoafricana* (Crous & T.A. Cout.)**

Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807842

Basionym. *Mycosphaerella pseudoafricana* Crous & T.A. Cout. (as *pseudoafricana*), *Stud. Mycol.* 55: 115. 2006.

≡ *Teratosphaeria pseudoafricana* (Crous & T.A. Cout.) Crous & U. Braun, *Stud. Mycol.* 58: 11. 2007.

Specimen examined. ZAMBIA, on leaves of *E. globulus*, Aug. 1995, T. Coutinho (holotype PREM 54973, culture ex-type CPC 1229, 1231, 1230 = CBS 114782).

***Teratosphaeriopsis* Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807843**

Type species. *Teratosphaeriopsis pseudoafricana* Quaedvlieg & Crous.

Etymology. Named after its morphological similarity to the genus *Teratosphaeria*.

Foliicolous, plant pathogenic. *Ascomata* black, erumpent, globose, solitary or in clusters of up to three, with papillate apex and central ostiole; wall consisting of 2–3 layers of medium brown *textura angularis*. *Asci* obovoid to broadly ellipsoid, aparaphysate, fasciculate, sessile, bitunicate, 8-spored, straight to slightly incurved. *Ascospores* tri- to multiseriate, hyaline, obovoid with rounded ends, medianly 1-septate, slightly constricted at the septum, straight to slightly curved, guttulate, thin-walled, widest in middle of apical cell; ascospores brown and verruculose at germination.

Notes — *Teratosphaeriopsis* is best distinguished from *Teratosphaeria* based on phylogenetic data, as several species in *Teratosphaeria* are morphologically similar.

***Teratosphaeriopsis pseudoafricana* Quaedvlieg & Crous, *sp. nov.* — MycoBank MB807844; Fig. 11**

Etymology. Name refers to its morphological similarity to *M. africana*.

Description on OA (homothallic). *Ascomata* black, erumpent, globose, solitary or in clusters of up to three, up to 120 µm diam, with papillate apex and central ostiole; wall consisting of 2–3 layers of medium brown *textura angularis*. *Asci* obovoid to broadly ellipsoid, aparaphysate, fasciculate, sessile, bitunicate, 8-spored, straight to slightly incurved; apical chamber 1.5–2 µm diam, 25–50 × 8–10 µm. *Ascospores* tri- to multiseriate, hyaline, obovoid with rounded ends, medianly 1-septate, slightly constricted at the septum, straight to slightly curved, guttulate, thin-walled, widest in middle of apical cell, (8–)9(–10) × (3–)3.5(–4) µm. *Ascospores* brown and verruculose at germination.

Culture characteristics — Colonies on OA iron-grey, spreading with moderate aerial mycelium in centre. On MEA and PDA erumpent, spreading, with folded surface, and moderate aerial mycelium, and even, lobed margin; centre olivaceous-grey, outer region iron-grey, reverse iron-grey; reaching 40 mm diam after 1 mo.

Specimen examined. SOUTH AFRICA, KwaZulu-Natal, on leaves of *Eucalyptus* sp., 23 Nov. 1995, P.W. Crous (holotype CBS H-21137, culture ex-type CBS 111171 = CPC 1261).

Notes — *Teratosphaeriopsis pseudoafricana* was originally identified as *Amycosphaerella africana* (= *Mycosphaerella africana*) based on morphology. Phylogenetically it is distinct from the taxa presently known to occur on eucalypts. Although the specimen has been lost, the fungus can still be described morphologically, as it is homothallic and sporulates in culture. *Ascospores* of *T. pseudoafricana* are obovoid, and shorter and wider than those of *Amycosphaerella africana*, which are fusoid-ellipsoidal, (7–)8–10(–11) × (2–)2.5–3 µm (Crous & Wingfield 1996).

***Xenopenidiella* Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807845**

Type species. *Xenopenidiella rigidophora* (Crous, R.F. Castañeda & U. Braun) Quaedvlieg & Crous.

Etymology. Named after the genus *Penidiella*, but distinct in having dimorphic conidiophores.

Hyphomycetous, saprobic on leaf litter. *Mycelium* consisting of strongly branched, septate, smooth, pale olivaceous to medium brown, guttulate, hyphae. *Conidiophores* dimorphic. *Macronematous conidiophores* separate, erect, subcylindrical, predominantly straight to slightly curved, terminally loosely branched; base neither lobed nor swollen, lacking rhizoids, septate, medium to dark brown. *Micronematous conidiophores* erect, subcylindrical, septate, pale to medium brown (concolorous with hyphae). *Conidiogenous cells* predominantly terminal,

rarely intercalary, medium brown, smooth, subcylindrical, but frequently swollen at apex, loci flat-tipped, sub-denticulate or not, barely to slightly thickened and darkened-refractive. *Conidia* in branched chains, medium brown, verruculose, ellipsoid to cylindrical-oblong, turning dark with age; hila sometimes slightly thickened and darkened, not refractive.

Notes — *Xenopenidiella* is superficially similar to *Penidiella*, but distinct in that conidiophores are dimorphic, not truly penicillate (rather loosely branched at apex), and conidiogenous cells often appear subdenticulate.

Xenopenidiella rigidophora (Crous, R.F. Castañeda & U. Braun) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807846

Basionym. *Penidiella rigidophora* Crous, R.F. Castañeda & U. Braun, Stud. Mycol. 58: 21. 2007.

Specimen examined. CUBA, isolated from leaf litter of *Smilax* sp. (*Smilacaceae*), 6 Nov. 1994, R.F. Castañeda (holotype CBS H-19938, culture ex-type CBS 314.95).

Xenoteratosphaeria Quaedvlieg & Crous, *gen. nov.* — MycoBank MB807847

Type species. *Xenoteratosphaeria jonkershoekensis* (P.S. van Wyk, Marasas & Knox-Dav.) Quaedvlieg & Crous.

Etymology. Resembling the genus *Teratosphaeria*, but with distinct culture characteristics.

Foliicolous, plant pathogenic. *Ascomata* immersed, substomatal, black, singular, gregarious, immersed, becoming erumpent through the stomatal pore, pyriform or globose with a papillate periphysate ostiole. *Asci* obclavate, straight, sessile or with a small pedicel, narrowing slightly to a rounded apex with a distinctive ocular chamber, 8-spored, bitunicate with fissitunicate dehiscence. *Ascospores* bi- to multiseriate, fusiform, tapering gradually to the rounded ends, widest in the middle of the upper cell, with the lower cell slightly narrower and longer, straight, hyaline, becoming pale brown with age, medianly septate.

Notes — *Xenoteratosphaeria* is morphologically similar to *Teratosphaeria* (also with ascospores becoming brown and verruculose in asci), but distinct in that in culture hyphae terminate in brown, multicellular chlamydospore-like structures, not observed in *Teratosphaeria* s.str. (see Crous et al. 2000, f. 18, 19, 25).

Xenoteratosphaeria jonkershoekensis (P.S. van Wyk, Marasas & Knox-Dav.) Quaedvlieg & Crous, *comb. nov.* — MycoBank MB807848

Basionym. *Mycosphaerella jonkershoekensis* P.S. van Wyk, Marasas & Knox-Dav., S. African J. Bot. 41: 234. 1975.

≡ *Teratosphaeria jonkershoekensis* (P.S. van Wyk, Marasas & Knox-Dav.) Crous & U. Braun, Stud. Mycol. 58: 10. 2007.

Specimen examined. SOUTH AFRICA, Western Cape Province, Jonkershoek, S33°59'4.2" E18°57'16.1", on living leaves of *Protea* sp., 1 Apr. 2007, P.W. Crous & L. Mostert (epitype CBS H-20095, culture ex-epitype CBS 122897 = CPC 13984).

DISCUSSION

The genus *Mycosphaerella* s.l. is one of the largest genera of ascomycetes with thousands of species (Crous 2009). However, the *Mycosphaerella* morphology evolved in many lineages independently, and the separation of the *Teratosphaeriaceae* from the *Mycosphaerellaceae* (Crous et al. 2007a) was an important step towards delimitation of taxa within the *Mycosphaerella* complex.

Mycosphaerella Leaf Disease

Mycosphaerella Leaf Disease is a serious impediment for the cultivation of eucalypts worldwide (Crous et al. 2009d, Hunter et al. 2011). Throughout the years numerous species of *Mycosphaerellaceae* and *Teratosphaeriaceae* have been described from eucalypt leaves, several of which have been associated with MLD and TLD. The present study provides a multigene DNA comparison of more than 146 taxa isolated from eucalypt leaves, and is the most comprehensive multigene DNA phylogeny generated to date for these fungi, following a previous study by Hunter et al. (2006). Numerous species examined here were originally described without isolation or preservation of ex-type strains, and consequently had to be recollected to enable DNA comparisons. Even though partial gene sequences of the ITS and LSU loci have been obtained for many of these fungi in recent years comprehensive multigene phylogenetic comparisons have mostly been lacking.

Lineages within the *Teratosphaeriaceae*

Schoch et al. (2006) placed the *Piedraiceae* in the *Dothideomycetes*, and Crous et al. (2009b) showed it clustered within the *Teratosphaeriaceae*. Ruibal et al. (2011) discussed this placement in depth and suggested that it was possibly due to long branch attraction and poor taxon sampling (these long branches are clearly visible in Fig. 3 derived from our LSU/RPB2 dataset). Although we have been unable to resolve the placement of the *Piedraiceae* in the present study, we still regard it as a separate family based on its unique morphology and ecology. Furthermore, the *Piedraiceae* clade was the only unstable clade in this dataset; e.g. it clustered as sister to different clades within the *Teratosphaeriaceae* depending on the addition/deletion of additional families to the dataset (results not shown) and was the only *Teratosphaeriaceae*-associated clade which actually clustered outside of the *Teratosphaeriaceae* while running preliminary Neighbour joining trees on our LSU/RPB2 dataset (results not shown). We await further insights on the correct placement of the *Piedraiceae*, which appears to be sensitive to sampling and different algorithms used for phylogenetic reconstruction.

Not all extremophiles could previously be accommodated in the *Teratosphaeriaceae* as some isolates clustered in closely related, but undescribed, separate families. Ruibal et al. (2009) resorted to referring to these rock-inhabiting isolates as being members of *Teratosphaeriaceae* ('clade 2'). Although the introduction of the *Neodevriesiaceae* and *Extremaceae* (Fig. 5) within the present study provide families for many of these extremophilic genera, the resulting *Teratosphaeriaceae* LSU/RPB2 tree (Fig. 3) is still not fully resolved. Overall, these results underline the fact that the *Teratosphaeriaceae* (Fig. 3) is still too broadly defined. A more robust dataset is needed to address this issue, within the wider context of what is now seen as the *Capnodiales*.

With the narrow circumscriptions of *Ramularia* (= *Mycosphaerella*) and *Teratosphaeria* (= *Kirramyces*), 23 novel genera have to be introduced to accommodate other monophyletic lineages in this complex. Although the present study presents a sound road map for future work on the *Teratosphaeriaceae*, it also illustrates that we are approaching the limits of purely morphology-based classification for species and genera within the *Mycosphaerellaceae* and *Teratosphaeriaceae*. Several genera that are readily identifiable based even on a single locus, are virtually impossible to distinguish by morphological means (e.g. *Parateratosphaeria* and *Teratosphaeria*) and this will pose problems for forest pathologists wanting to identify these taxa in the field.

Best genes to distinguish species in *Mycosphaerellaceae* and *Teratosphaeriaceae*

From the DNA sequence data we conclude that any of the five coding loci tested in this study (Btub, Act, RPB2, EF-1 α and Cal) will reliably identify most of the species studied. The only exception was species of *Pseudocercospora*, which were difficult to identify based on a single locus, although this had already been demonstrated (Crous et al. 2013). The Act, Cal and Btub genes were incongruent with the other loci in the two five-locus datasets. However, this does not exclude these genes as barcoding loci for species identification within the MLD and TLD complexes, as these loci resolve the terminal clades in their derived trees, if not their higher order clustering. These 'aberrant' loci should not be combined with other loci within these two datasets, if the intention is to draw taxonomic conclusions about the relationships of these species to one another. This incongruity can be caused by several factors, including differing rates of evolution, and different selection pressures.

As none of the coding gene loci had a 100 % amplification success rate, none of these loci alone are ideal for species identification in a generic protocol. The two loci that did have a 100 % success rate (LSU and ITS) lack species resolution power for a large number of species, and are thus not independently reliable as an identification tool. The Btub and EF-1 α loci have the highest Kimura-2-parameter distances, with RPB2 in the third place (i.e. they show the highest natural variation between species) for the species used in this dataset, but these loci have the disadvantage that they only have amplification success rates of 97, 98 and 95 %, respectively (Table 3).

To compensate for both this lack of amplification success and the limited amount of available reference data for these protein coding loci in public databases, we recommend a combination of a primary and a secondary locus to provide a more reliable identification result. The ITS locus is a prime candidate as the primary locus as the ITS locus has recently been proposed as the primary fungal barcoding locus (Schoch et al. 2012), and ITS sequence data are easily obtained and are a good starting point to rapidly identify genera and often species. If an unknown genus or species is not represented in a curated database such as Q-bank (www.q-bank.eu), then GenBank should be used to supplement the data. As a secondary identification locus, either Btub, EF-1 α or even RPB2, suffice for many species of *Mycosphaerellaceae* or *Teratosphaeriaceae*. We recommend EF-1 α , followed by Btub and then RPB2, as the most effective way of identifying many species within these genera. As with all molecular-based identification approaches, care needs to be taken with the interpretation of results arising from such analyses, as many mistakes occur in uncurated public nucleotide databases such as GenBank.

Species concepts within the fungal kingdom

Ever since Darwin (1859) published his species concept in 'On the Origin of Species', scientists have been struggling with how to define and recognise species, i.e., when has a lineage diverged far enough to be considered a species. Numerous authors have since considered a multitude of taxonomic characters as essential elements to define novel species. Authors commonly disagree about species numbers and species boundaries. Species delimitation and conceptualisation has become increasingly confused by disagreements about species concepts (de Queiroz 2007, Costello et al. 2013).

Some of the more ambiguous phylogenetic conclusions in the present study demonstrate the problems experienced when defining species. For example, Fig. 1, clade C reveals that the four tested *T. gauchensis* isolates (Cortinas et al. 2006) have extensive natural variation within the seven loci tested, which causes them to overlap with two other, morphologically distinct

species, *T. stellenboschiana* and *T. foliensis*. Does this mean that these eight *Teratosphaeria* isolates belong to one, two or more different taxa?

Traditionally, five previously described species concepts have been used in mycology to distinguish taxa. The Biological Species Concept (BSC) emphasizes reproductive isolation (Wright 1940, Mayr 1942), the Morphological Species Concept (MSC) emphasizes morphological divergence, the Ecological Species Concept (ESC) emphasizes adaptation to a particular ecological niche (van Valen 1976), the Phylogenetic Species Concept (PSC) emphasizes nucleotide (non) divergence (Hennig 1966) and the Genealogical Concordance Phylogenetic Species Recognition (GCPSR) (an adaptation of the PSC) uses the phylogenetic concordance of unlinked genes to indicate a lack of genetic exchange and thus, evolutionary independence of lineages (O'Donnell et al. 1998, Taylor et al. 2000, Dettman et al. 2003a, b, de Queiroz 2007).

During the last decade a sixth, polyphasic approach to species recognition has evolved within the mycological community. This polyphasic method grades the MSC, ESC and PSC characteristics with a variable weight in order to reach a conclusion on the proposition that a taxon represents a separate species. Conclusions based on the molecular similarity between different taxa in a robust multi-locus DNA dataset (PSC) are generally unbiased and warrant a high weight in any CSC analysis conclusion. Differences in morphology (MSC) and ecology (ESC) are given less weight in reaching a CSC conclusion. This approach has become generally accepted during the last decade as a functional species concept within the mycological community, without ever officially having been described as such (Frisvad & Samson 2004, Crous & Groenewald 2005, Samson et al. 2006, Leslie & Summerell 2006, Cai et al. 2009, Groenewald et al. 2013). To remedy this, we propose to formally name this widely used, polyphasic method for identifying species within the fungal kingdom, as the Consolidated Species Concept (CSC) (derived from a discussion with Keith Seifert about how to describe the polyphasic identification approach at the 'One Fungus = Which Name' symposium, held in Amsterdam in April 2012).

Even with the use of these six species concepts, successfully distinguishing between two or more closely related taxa can still be daunting and open to debate. The generated phylogenetic trees (Fig. 1–4) show several of these closely related isolates (clades A–K) that have previously been identified as belonging to different taxa. These clades will therefore be discussed in more detail under the listed species concepts.

As we did not perform mating compatibility tests on this dataset, we have no data regarding the BSC concept for most of these isolates. However, we can discuss the implications of the five remaining species concepts (MSC, ESC, PSC, GCPSR and CSC) on this dataset.

Different conclusions can be drawn about speciation, when applying these five species concepts individually to clade C (Fig. 1). Clade C contains seven isolates that were previously identified as either one of two closely related *Teratosphaeria* species (*T. gauchensis* or *T. stellenboschiana*). Each one of these two species has a distinct morphology (Crous et al. 2004b, 2009a, Andjic et al. 2010), was isolated from a different host (*E. grandis* and *E. punctata*) and collected from different continents (Africa and South America). So, according to both the MSC and the ESC concepts, there is very good support for the proposition that they should be regarded as separate species. However, the PSC concept is inconclusive in this case as the four *T. gauchensis* isolates show a wide genetic drift while the *T. stellenboschiana* isolates are relatively conserved.

When applying the GCPSR concept to this dataset, the taxa within this dataset are tested for genetic exchange to indicate

their evolutionary independence (a pairwise homoplasy index (PHI or Φ_w) score below 0.05 is considered proof for the presence of significant recombination within the dataset). The GCPSR test revealed that there was no significant genetic recombination within this dataset ($\Phi_w = 0.1$) (Fig. 6c). There are still common (but not significant) recombination events present within this dataset, as is apparent by the relative low Φ_w and the conflicting phylogenetic splits (another indicator of recombination) observed in the split tree decomposition network for the *T. gauchensis* and *T. stellenboschiana* isolates (Fig. 6c). According to the GCPSR species concept, there is no support for the proposition that these isolates belong to the same species, as there was no significant recombination between *T. gauchensis* and *T. stellenboschiana*.

When applying the CSC concept to clade C, we can take into account that the phylogenetic data regarding *T. stellenboschiana* and *T. gauchensis* is ambiguous as the variation within the *T. gauchensis* isolates more or less overlaps with the *T. stellenboschiana* isolates, but the ecological and morphological criteria support the proposition that these isolates belong to two distinct taxa. So when combining the MSC, ESC and PSC characteristics into a CSC conclusion on speciation, we can conclude that there is good support for the proposition that these isolates actually belong to two distinct taxa.

We can now also apply the CSC concept to the rest of the clades, marked A to K, in Fig. 1 and 2.

Clade A

contains 12 isolates previously identified as either belonging to closely related *Teratosphaeria nubilosa* or *T. pseudonubilosa* (including the ex-type of *T. nubilosa*, CBS 116005) and were isolated from either *Eucalyptus globulus* or *Eucalyptus* sp. hosts from the same continent (Australia). These two species show very little morphological variation and cannot be separated by morphological characteristics. Differentiation of these species is based on SNPS in 29, separately analysed gene regions, and on four nucleotide characters in the ITS and six nucleotides in the Btub loci (Pérez et al. 2013). These two species are phylogenetically distinct over the five test loci (Fig. 1) (which also includes the ITS and Btub loci). When applying the GCPSR concept to these 12 isolates, we detect no significant recombination events shared between these isolates ($\Phi_w = 0.07$) (Fig. 6a). This lack of significant recombination does not mean that there are no shared recombination events. As the Φ_w value approximates 0.05, this indicates that there are some shared insignificant recombination events between these isolates. This example also shows the limitations of the GCPSR concept, which looks for significant recombination events in a black and white way, ignoring borderline cases. When applying the CSC concept to clade A, we conclude that there is reasonable support for the proposition that these isolates belong to different taxa even as the morphological and ecological criteria are inconclusive as we have a clear phylogenetic separation between these two *Teratosphaeria* taxa.

Clade B

contains three isolates that were previously classified as either closely related to *T. destructans* (ex-type CBS 111370) or *T. viscidus* (ex-type CBS 124992), which were isolated from either *Eucalyptus grandis* or *E. nitens*, from two different continents (Indonesia and Australia). These two species can be separated by morphological characteristics (Andjic et al. 2007). Both species are phylogenetically (Fig. 1) distinct over the five test loci and when applying the GCPSR concept to these isolates, we did not detect significant recombination between the isolates ($\Phi_w = 1$) (Fig. 6b). Because the Φ_w test requires a minimum of four isolates, an isolate of *T. eucalypti*

was added to this dataset. When applying the CSC concept to clade B, we can take into account that the MSC, ESC and PSC characteristics all support the two species proposition so we conclude that there is full support for the proposition that *T. destructans* and *T. viscidus* represent two different taxa.

Clade D

contains two isolates that were previously identified as either belonging to the closely related *T. pluritubularis* and *T. profusa* (including the respective ex-type isolates CBS 118508 and CBS 125007; Crous et al. 2006), which were isolated from either *E. globulus* or *E. nitens* from different continents (Spain and Australia). Both species have distinct morphological variation and can be separated based on morphological characteristics (Crous et al. 2009b). These two species are phylogenetically (Fig. 1D) very closely related but distinct over the five test loci. However, when applying the GCPSR concept to these isolates, we detect significant recombination between these isolates ($\Phi_w < 0.001$) (Fig. 6d). To obtain a minimum of four isolates, isolates of *T. complicata* and *T. caesia* were added to this dataset. Multiple combinations of closely related *Teratosphaeria* species were tested, but only the combinations that included both the *T. pluritubularis* and *T. profusa* isolates showed significant recombination in their Φ_w (results not shown). When applying the CSC concept to clade D, the MSC, ESC and PSC characteristics all support the two species proposition so we conclude that there is full support for the proposition that *T. pluritubularis* and *T. profusa* represent two different taxa. These results conflict, as we have two morphologically and ecologically distinct taxa that have very strong and recent family ties (as shown by the GCPSR test results). It is possible that these two species recently underwent speciation and that the loci selected for molecular comparison have not evolved sufficiently individually to provide higher phylogenetic support.

Clade E

contains eight isolates that were previously identified as *Austroafricana parva* (= *T. parva*) based on limited morphology and ITS sequence data. Strains were isolated from both *Eucalyptus* and *Protea* hosts located on three different continents (Australia, Egypt, Portugal, South Africa). Although these isolates are morphologically very similar and have a high degree of conservation in their ITS sequences, they are phylogenetically very distinct over the five test loci and even form four to five subclades (indicating that this might actually be a species complex). When applying the GCPSR concept to these isolates, we detect significant recombination between these isolates ($\Phi_w < 0.001$) (Fig. 6e). Multiple combinations of these eight isolates were tested and significant recombination was detected within two separate groups. Group one consists of CBS 119901, 116289, 122892 and CPC 12249, while group two consists of CBS 122893 and 114761 (results not shown). These results correspond to the phylogenetic tree (Fig. 1E) in which the isolates within these two groups are closely related. When applying the CSC concept to clade E, we see only limited (MSC) support for the single species proposition and much stronger (ESC and PSC) support for the proposition that these isolates actually represent four to five different taxa. But more detailed morphological future work is needed to confirm this proposition.

Clade F

contains six isolates that had previously been identified as *Austroafricana associata* (= *A. associata*) based on limited morphological characters and ITS sequence data. These isolates were isolated from different *Eucalyptus* and *Corymbia* hosts in Australia and they are phylogenetically highly distinct over the five test loci, and even form five to six subclades (indicating

that this might actually be a species complex). When applying the GCPSR concept to these isolates, we detect significant recombination between these isolates ($\Phi_w = < 0.001$) (Fig. 6f). Multiple combinations of these six isolates were tested and this significant recombination was limited between two isolates (CBS 112224 and CPC 13113) (results not shown). When applying the CSC concept to clade F, we see only limited (MSC) support for the single species proposition and much stronger (ESC and PSC) support for the proposition that these isolates actually represent five or six different taxa. But more detailed morphological future work is needed to confirm this proposition.

Clade G

contains two isolates that had previously been identified as *Pseudoteratosphaeria parkii* (ex-type CBS 120737) or *Pet. stramenticola* (ex-type CBS 118506). Both strains were isolated from *Eucalyptus* hosts (*E. urophylla* and *Eucalyptus* sp.) from South America (Venezuela and Brazil). Both species are morphologically similar to one another (Crous et al. 2006, 2007c), and are phylogenetically indistinguishable over the five test loci (Fig. 1). When applying the GCPSR concept to these isolates, we detect significant recombination between these two isolates ($\Phi_w = 0.03$) (Fig. 6g). Because the Φ_w test requires a minimum of four isolates, isolates of *Pet. perpendicularis* and *Pet. gamsii* were added to this dataset. Multiple combinations of closely related *Pseudoteratosphaeria* species were tested, but only the combinations that included both the *Pet. parkii* and *Pet. stramenticola* isolates showed significant recombination in their Φ_w (results not shown). When applying the CSC concept to clade G, we get full support for the proposition that these isolates actually belong to the same taxon. The CSC data suggests that these two isolates actually belong to the same taxon and this could be confirmed with more detailed morphological work and these species are subsequently synonymised.

Clade H

contains six isolates that were previously identified as either belonging to closely related *Pallidocercospora thailandica* (ex-type CBS 120723) or *P. colombiensis* (ex-type CBS 110967). All *P. colombiensis* isolates were isolated from *E. urophylla* in Colombia while the *P. thailandica* isolates had a mixed host range from *Acacia* and *Musa* to *E. camaldulensis* in Thailand, Brazil and Cameroon. Both species are morphologically distinct (Crous et al. 2004c) but are phylogenetically difficult to distinguish over the five tested loci (Fig. 2H). When applying the GCPSR concept to these isolates, we detect no significant recombination among these isolates ($\Phi_w = 1.0$) (Fig. 6h). When applying the CSC concept to clade H, we see no support for the single species proposition and stronger (ESC and MSC) support for the proposition that these isolates indeed represent two different taxa.

Clade I

contains three isolates previously identified as either closely related (Crous et al. 2013) *Pseudocercospora fori* (ex-type CBS 113285) or *Ps. natalensis* (ex-type CBS 111069). Both taxa were described from *Eucalyptus* species (*E. grandis* and *E. nitens*) collected in South Africa. Morphologically, they are distinguishable based on the number of conidial septa (Crous 1998, Hunter et al. 2004) but phylogenetically they are difficult to distinguish over the five tested loci (Fig. 2i). Application of the GCPSR concept, showed no significant recombination ($\Phi_w = 0.11$) (Fig. 6i). Because the Φ_w test requires a minimum of four isolates, an isolate of *Ps. subulata* was added to this dataset. When applying the GCPSR concept to clade I, we see no support for the single species proposition and good support (ESC, PSC and MSC) for the proposition that these isolates indeed represent two different taxa.

Clade J

contains 24 isolates that were previously identified as either belonging to *Pseudocercospora gracilis* (ex-type CBS 111189) or *Ps. eucalyptorum* (ex-type CBS 114866). Both species were described from several *Eucalyptus* hosts. While *Ps. eucalyptorum* occurs in Europe, Africa and Australia, *Ps. gracilis* is only known from South-East Asia. The two species are morphologically distinct based on differences in their conidial morphology (Crous et al. 1989, Crous & Alfenas 1995) and also phylogenetically distinguishable over the five tested loci (Fig. 2J). When applying the GCPSR concept to these isolates, we detect no significant recombination between these isolates ($\Phi_w = 0.8$) (Fig. 6j). When applying the CSC concept to clade J, we see full (MSC, ESC and PSC) support for the two species, so we conclude that there is full support for the proposition that *P. eucalyptorum* and *P. gracilis* represent two different taxa.

Clade K

contains 12 isolates previously identified as *Zasmidium citri* based on limited morphology and ITS sequence data. These isolates were isolated from a mixed host range (*Acacia*, *Musa*, *Citrus* and *Eucalyptus*) from both South-East Asia and North America. These isolates are phylogenetically distinct over the five test loci and even form five to six subclades (indicating that this is actually a species complex) (Fig. 2K). When applying the GCPSR concept to these 12 isolates, we detect significant recombination between these isolates ($\Phi_w = < 0.001$) (Fig. 6k). However, Φ_w testing of multiple isolate combinations within the 12 species dataset showed that the significant recombination in the pairwise homoplasy index were limited to four isolates most likely comprising two separate species (CPC 15289 / CPC 15296 and CPC 10522 / CBS 116366) (data not shown). When applying the CSC concept to clade K, we only see low (MSC) support for the proposition that these isolates actually belong to the same taxon, and much higher (PSC and ESC) support for the proposition that these isolates actually belong to the different taxa, but more detailed morphological work is needed to confirm this proposition.

In the present study we introduced the Consolidated Species Concept to distinguish species of *Teratosphaeriaceae* identified via a polyphasic approach, combining morphological, ecological and phylogenetic species concepts. We also tried to provide a better phylogenetic backbone for the *Teratosphaeriaceae*, which contains numerous plant and human pathogens, but also saprobes, endophytes, and rock-inhabiting fungi. Although we were able to introduce the *Extremaceae* and *Neodevriesiaceae* to accommodate a group of extremophilic fungi that occur on a range of diverse substrates, we were unable to resolve the phylogenetic position of the *Piedraiaceae* in relation to the *Teratosphaeriaceae*. At a generic level, *Mycosphaerella* and *Teratosphaeria* are now well defined, with an additional 23 genera being introduced for distinct phylogenetic lineages. Many lineages remain yet unresolved and are treated as either *Teratosphaeria* sp. or *Teratosphaeriaceae*, awaiting further collections to hopefully add additional morphological characters to these unnamed generic clades, many which remain poorly understood, and greatly undersampled.

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