

A systematic account of the genus *Plagiostoma* (Gnomoniaceae, Diaporthales) based on morphology, host-associations, and a four-gene phylogeny

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Abstract: Members of the genus *Plagiostoma* inhabit leaves, stems, twigs, and branches of woody and herbaceous plants predominantly in the temperate Northern Hemisphere. An account of all known species of *Plagiostoma* including *Cryptodiaporthe* is presented based on analyses of morphological, cultural, and DNA sequence data. Multigene phylogenetic analyses of DNA sequences from four genes (β -tubulin, ITS, *rpb2*, and *tef1-a*) revealed eight previously undescribed phylogenetic species and an association between a clade composed of 11 species of *Plagiostoma* and the host family *Salicaceae*. In this paper these eight new species of *Plagiostoma* are described, four species are redescribed, and four new combinations are proposed. A key to the 25 accepted species of *Plagiostoma* based on host, shape, and size of perithecia, perithecial arrangement in the host, and microscopic characteristics of the asci and ascospores is provided. Disposition of additional names in *Cryptodiaporthe* and *Plagiostoma* is also discussed.

Key words: Ascomycota, Betulaceae, epitypification, *Fraxinus*, new species, phylogeny, Salicaceae, Sordariomycetidae.

Taxonomic novelties: *Plagiostoma dilatatum* L.C. Mejía, sp. nov., *Plagiostoma extocollum* L.C. Mejía, sp. nov., *Plagiostoma imperceptibile* L.C. Mejía, sp. nov., *Plagiostoma oregonense* L.C. Mejía, sp. nov., *Plagiostoma ovalisporum* L.C. Mejía, sp. nov., *Plagiostoma samuelsii* L.C. Mejía, sp. nov., *Plagiostoma versatile* L.C. Mejía & Sogonov, sp. nov., *Plagiostoma yunnanense* L.C. Mejía & Zhu L. Yang, sp. nov., *Plagiostoma apiculatum* (Wallr.) L.C. Mejía, comb. nov., *Plagiostoma convexum* (Preuss) L.C. Mejía, comb. nov., *Plagiostoma populinum* (Fuckel) L.C. Mejía, comb. nov., *Plagiostoma pulchellum* (Sacc. & Briard) L.C. Mejía, comb. nov.

INTRODUCTION

The genus *Plagiostoma* (Gnomoniaceae, Diaporthales) includes microscopic fungi that inhabit the leaves, stems, twigs, and branches of woody and herbaceous plants from a range of families including the *Betulaceae*, *Euphorbiaceae*, *Geraniaceae*, *Hippocastanaceae*, *Oleaceae*, *Polygonaceae*, *Salicaceae*, *Sapindaceae*, and *Staphylaceae* in temperate regions of the Northern Hemisphere (Sogonov *et al.* 2008). Although some species of *Plagiostoma* cause diseases, most do not show symptoms prior to production of perithecia on dead tissues. Described by Fuckel (1870), the morphological concept of *Plagiostoma* remained relatively unchanged (Barr 1978, Monod 1983) until recently. Multigene phylogenetic studies suggest that the genus *Plagiostoma* forms a highly supported monophyletic clade that includes the type species of *Plagiostoma*, *P. euphorbiae*, and the type species of *Cryptodiaporthe*, *C. aesculi*, among others (Mejía *et al.* 2008, Sogonov *et al.* 2008). Sogonov *et al.* (2008) included 13 species in the genus *Plagiostoma*, several of which were previously placed in *Cryptodiaporthe*.

A brief historical account of the major taxonomic treatments of *Plagiostoma* and *Cryptodiaporthe* illustrates the views of these genera through time. Fuckel (1870) proposed the genus *Plagiostoma* for sphaericeous species characterised by flattened perithecia oriented horizontally having short, lateral, erumpent necks. Fuckel (1870) included the genera *Ceratostoma*, *Gnomonia*, *Linospora*, *Melanospora*, and *Rhaphidospora* together with *Plagiostoma* in the tribe *Ceratostomeae* of the *Sphaeriacei*. In his original description of *Plagiostoma*, Fuckel (1870) included four

species, *P. euphorbiae*, *P. petiolicola*, *P. devexum*, and *P. suspecta*. Fuckel's concept of *Plagiostoma* was followed by Höhnelt (1917) and von Arx (1951) who, like Fuckel, considered *Plagiostoma* to be relatively closely related to *Gnomonia*, the name on which the *Gnomoniaceae* is based. These authors differentiated *Gnomonia* from *Plagiostoma* mainly by orientation of the perithecial neck. *Gnomonia* was characterised by having central, upright, perithecial necks in contrast to species of *Plagiostoma* with eccentric, laterally oriented, perithecial necks. In her treatment of the order *Diaporthales*, Barr (1978) followed Fuckel's concept of *Plagiostoma* and placed *Gnomonia* and *Plagiostoma* in the same suborder *Gnomoniineae* but in different families, *i.e.* *Gnomonia* in the *Gnomoniaceae* and *Plagiostoma* in the *Valsaceae*. The *Valsaceae* was defined based on having "beaks oblique or lateral, erumpent separately or converging through stromatic disc" (Barr, 1978 p. 15). Barr (1978) made nine new combinations in *Plagiostoma* expanding the number of species in the genus to 13.

In his monograph of the *Gnomoniaceae*, Monod (1983) accepted most species treated by Barr (1978). However, Monod considered that the typification of *Plagiostoma* as *P. euphorbiae* by Höhnelt (1917) was not representative of *Plagiostoma* because the perithecial necks of this species are eccentric rather than lateral as stipulated by Fuckel (1870). Monod (1983) transferred *P. euphorbiae* to the genus *Gnomonia* and re-typified *Plagiostoma* with *P. devexum*. In agreement with Barr (1991) and Sogonov *et al.* (2008) the typification of the genus *Plagiostoma* with *P. euphorbiae* by Höhnelt (1917) is accepted here because this typification predates Monod (1983) and is in accordance with Article 10 of the International Code of Botanical Nomenclature (McNeill *et al.* 2006).

Table 1. Isolates with sequences included in the phylogenetic analysis of *Plagiostoma*. Types and epitypes are indicated in bold.

Taxon	Specimen	Culture	Country	Host	Collector	<i>β-tubulin</i>	ITS	<i>rpb2</i>	<i>tef1-α</i>
<i>Apiognomonia hystrix</i>	CBS-H 11343	CBS 911.79	Switzerland	<i>Acer pseudoplatanus</i>	M. Monod	GU366973	DQ313549	EU219260	GU353957
<i>Apiognomonia veneta</i>	NA	CBS 897.79	Switzerland	<i>Platanus orientalis</i>	M. Monod	GU377974	DQ313532	EU219259	GU353958
<i>Plagiostoma aesculi</i>	BPI 748430	CBS 109765	Austria	<i>Aesculus hippocastaneum</i>	W. Jaklitsch	GU367021	DQ323530	EU199138	GU354004
	BPI 878950	CBS 126127 (= LCM 447.01)	Germany	<i>Aesculus hippocastaneum</i>	L.C. Mejía	GU367019	GU367076	GU367110	GU354002
	BPI 878950	LCM 447b.01	Germany	<i>Aesculus hippocastaneum</i>	L.C. Mejía	GU367020	GU367077	GU367111	GU354003
	BPI 840942	CBS 121905	Austria	<i>Aesculus hippocastaneum</i>	W. Jaklitsch	GU367022	EU254994	EU219269	GU354005
<i>Plagiostoma amygdalinae</i>	NA	CBS 791.79	Switzerland	<i>Euphorbia amygdaloides</i>	M. Monod	GU367030	EU254995	GU367113	GU354012
<i>Plagiostoma apiculatum</i>	BPI 747938	CBS 109775 (= AR 3455)	Austria	<i>Salix</i> sp.	W. Jaklitsch	GU367008	DQ323529	EU199141	GU353990
	BPI 878951	LCM 393.01	France	<i>Salix dasyclados</i>	L.C. Mejía	GU367010	GU367067	GU367101	GU353992
	BPI 878952	CBS 126126 (= LCM 436.01)	USA: WA	<i>Salix sitchensis</i>	L.C. Mejía	GU367009	GU367066	GU367100	GU353991
<i>Plagiostoma barriae</i>	BPI 878954	LCM 601.01	USA: WA	<i>Acer macrophyllum</i>	L.C. Mejía	GU366996	GU367054	GU367091	GU353980
<i>Plagiostoma convexum</i>	BPI 843490	CBS 123206	USA: NY	<i>Salix</i> sp.	L. Vasilyeva	GU367011	EU255047	-	GU353994
<i>Plagiostoma devexum</i>	BPI 843489	CBS 123201	USA: NY	<i>Polygonum</i> sp.	L. Vasilyeva	GU367027	EU255001	EU219258	GU354010
<i>Plagiostoma dilatatum</i>	BPI 878957	CBS 124976 (= LCM 402.02)	France	<i>Salix irrorata</i>	L.C. Mejía	GU367013	GU367070	GU367104	GU353996
	BPI 878958	LCM 403.02	France	<i>Salix caprea</i>	L.C. Mejía	GU367012	GU367069	GU367103	GU353995
<i>Plagiostoma euphorbiaceum</i>	NA	CBS 816.79	Switzerland	<i>Euphorbia palustris</i>	M. Monod	GU367031	EU255003	-	GU354013
<i>Plagiostoma euphorbiae</i>	NA	CBS 340.78	The Netherlands	<i>Euphorbia palustris</i>	W. Gams	GU367034	DQ323532	EU219292	GU354016
<i>Plagiostoma exstocollum</i>	BPI 878961	CBS 127662 (= LCM 468.01)	USA: OR	<i>Corylus californica</i>	L.C. Mejía	GU366988	GU367046	GU367086	GU353972
	BPI 878959	LCM 422.01	USA: OR	<i>Corylus californica</i>	L.C. Mejía	GU366985	GU367043	GU367085	GU353969
<i>Plagiostoma fraxini</i>	BPI 746412	CBS 109498	USA: MD	<i>Fraxinus pennsylvanica</i>	S. Redlin	GU367033	AY455810	EU219263	GU354015
<i>Plagiostoma geranii</i>	NA	CBS 824.79	Switzerland	<i>Geranium sylvaticum</i>	M. Monod	GU367032	EU255009	EU219273	GU354014
<i>Plagiostoma imperceptibile</i>	BPI 878967	LCM 456.01	USA: CA	<i>Salix</i> sp.	L.C. Mejía	GU367002	GU367059	GU367094	GU353984
<i>Plagiostoma oregonense</i>	BPI 878968	CBS 126124 (= LCM 597.01)	USA: OR	<i>Salix</i> sp.	L.C. Mejía	GU367016	GU367073	GU367107	GU353999
<i>Plagiostoma ovalisporum</i>	BPI 878969	CBS 124977 (= LCM 458.01)	USA: ID	<i>Salix</i> sp.	L.C. Mejía	GU367015	GU367072	GU367106	GU353998
<i>Plagiostoma petiophilum</i>	BPI 878970	CBS 126123 (= LCM 181.01)	USA: NY	<i>Acer spicatum</i>	L.C. Mejía	GU367023	GU367078	GU367112	GU354006
	BPI 863769	AR 3821	USA: NY	<i>Acer</i> sp.	L. Vasilyeva	GU367025	EU255039	EU219257	GU354008
<i>Plagiostoma populinum</i>	NA	CBS 144.57	The Netherlands	<i>Populus trichocarpa</i>	B. Gerrits van den Ende	GU367018	GU367075	GU367109	GU354001
	NA	CBS 174.58	The Netherlands	<i>Populus canadensis</i>	B. Gerrits van den Ende	GU367017	GU367074	GU367108	GU354000
<i>Plagiostoma pulchellum</i>	BPI 878971	CBS 126653 (= LCM 365.04)	USA: MD	<i>Salix babylonica</i>	L.C. Mejía	GU367006	GU367063	GU367098	GU353987
	BPI 878972	LCM 371.02	USA: MD	<i>Salix babylonica</i>	L.C. Mejía	GU367007	GU367064	GU367099	GU353988
	BPI 878973	LCM 438.04	USA: WA	<i>Salix lucida</i>	L.C. Mejía	GU366004	GU367061	GU367096	GU353985
	BPI 878974	LCM 623.01	Argentina	<i>Salix humboldtiana</i>	L.C. Mejía	GU367005	GU367062	GU367097	GU353986
	NA	CBS 170.69	The Netherlands	<i>Populus balsamifera</i>	Unknown	-	EU255043	-	GU353989
<i>Plagiostoma rhododendri</i>	NA	CBS 847.79	Switzerland	<i>Rhododendron hirsutum</i>	M. Monod	GU367026	EU255044	EU2192578	GU354009
<i>Plagiostoma robergeanum</i>	BPI 843593	CBS 121472	Austria	<i>Staphylea pinnata</i>	W. Jaklitsch	GU367029	EU255046	EU219262	GU354011
<i>Plagiostoma salicellum</i>	BPI 843527	CBS 121466 (= AR 3828)	Austria	<i>Salix alba</i>	W. Jaklitsch	GU366978	EU254996	EU219278	GU353962
	BPI 878975	CBS 126121 (= LCM 449.01)	Germany	<i>Salix repens</i>	L.C. Mejía	GU366977	GU367037	GU367081	GU353961
<i>Plagiostoma samuelsii</i>	BPI 878977	CBS 125668 (= LCM 454.04)	USA: CA	<i>Alnus tenuifolia</i>	L.C. Mejía	GU366993	GU367051	GU367089	GU353977
	BPI 878979	LCM 596.01	USA: WA	<i>Alnus</i> sp.	L.C. Mejía	GU366994	GU367052	GU367090	GU353978
<i>Plagiostoma versatile</i>	BPI 878980	CBS 124978 (= LCM 594.01)	USA: WA	<i>Salix scouleriana</i>	L.C. Mejía	GU366979	GU367038	GU367082	GU393963
	BPI 878981	LCM 595.01	USA: WA	<i>Salix scouleriana</i>	L.C. Mejía	GU366980	GU367039	GU367083	GU393964
	BPI 878982	LCM 598.01	USA: OR	<i>Salix</i> sp.	L.C. Mejía	GU366981	GU367040	GU367084	GU393965
	BPI 877702	CBS 121251	Canada	<i>Salix</i> sp.	M.V. Sogonov	GU366982	EU255059	EU219268	GU393966

Table 1. (Continued).

Taxon	Specimen	Culture	Country	Host	Collector	β -tubulin	ITS	rpb2	tef1- α
<i>Plagiostoma yunnanense</i>	BPI 878983	CBS 124979 (= LCM 513.03)	China	<i>Salix</i> sp.	L.C. Mejía	GU366975	GU367035	GU367079	GU353959
<i>Plagiostoma yunnanense</i>	BPI 878983	LCM 513.02	China	<i>Salix</i> sp.	L.C. Mejía	GU366976	GU367036	GU367080	GU353960

In addition, the character of perithecial neck orientation has been found not to be phylogenetically informative (Sogonov *et al.* 2008).

Cryptodiaporthe was described by Petrak (1921) for species with euvalsoid arrangement of perithecia and, in contrast to *Diaporthe*, lacks a blackened margin in the substratum surrounding the perithecia. In describing *Cryptodiaporthe*, Petrak (1921) designated *C. aesculi* as type and included *C. hystrix* and *C. populina*. Later, Wehmeyer (1933) recircumscribed *Cryptodiaporthe* emphasising the lack of a blackened margin within the substratum and made 17 new combinations in this genus for species previously included in *Diaporthe* expanding the genus to 19 species.

In this study, specimens of *Plagiostoma* were collected primarily from North America but also from South America, Europe, and China. Among these recent collections eight new species were discovered and a number of described species were recollected, cultured, and sequenced. A multigene phylogenetic analysis is provided of 24 of the 25 species of *Plagiostoma* accepted here. Eight new species are described and illustrated, four species are redescribed, and four new combinations are proposed. A key to the 25 accepted species of *Plagiostoma* is provided along with the disposition of additional species names in *Cryptodiaporthe* and *Plagiostoma*.

MATERIAL AND METHODS

Collection of specimens, culture preparation, and morphological observations

Collections were made as listed in Table 1 from the following countries mainly during the spring and summers of 2007 and 2008: Argentina (Tucumán), China (Yunnan), France (Deux-Sèvres Département), Germany (Frankfurt), and the United States of America (California, Maryland, New York, Oregon, Washington). Specimens consisting of overwintered, dead, attached, or fallen twigs and branches with perithecia were placed in paper bags, air-dried, and stored at 8–10 °C in sealed plastic bags for a period of 1 wk to 6 mo before processing. All specimens are deposited in the U.S. National Fungus Collections (BPI).

Observations, measurements, and digital imaging of morphological characters and isolation of cultures were performed using the same equipment and procedures as in Mejía *et al.* (2008). AxioVision v. 4.7.2.0 (Carl Zeiss Image Solutions, Carl Zeiss, New York, NY, USA) was used in conjunction with those methods to measure structures. Fresh specimens were mounted in water for microscopic observations; dried specimens were mounted in 3 % potassium hydroxide. Cultural characteristics were observed on Potato Dextrose Agar (PDA, Difco™, Becton, Dickinson & Co., Sparks, MD, USA) 7 d after plating as described in Mejía *et al.* (2008). Colony diameters were measured twice perpendicularly and averaged and thus are listed as average colony diameter (a.c.d.). Representative cultures of species considered in this study were deposited at the Centraalbureau voor Schimmelcultures (CBS, The Netherlands) as listed in Table 1.

DNA extraction and PCR amplification

DNA extractions were done as described by Mejía *et al.* (2008) using a Fast Prep FP 120 with Lysing Matrix "A" (MP Biomedicals, Solon, OH, USA) for mechanical lysis. Four gene fragments were amplified and sequenced for the phylogenetic analyses: the complete nuclear ribosomal internal transcribed spacer regions 1 and 2 including 5.8 S rDNA (ITS), regions of the RNA polymerase second largest subunit (*rpb2*), beta-tubulin (β -tubulin), and translation elongation factor 1-alpha (*tef1*- α) genes. The ITS and *rpb2* genes were amplified and sequenced as described in Mejía *et al.* (2008) in 25 μ L reactions with two internal sequencing primers designed specifically for species of *Plagiostoma*: *rpb2* Plag-F (5' CGT CGC TGC ATY ATC TCR CA 3') and *rpb2* Plag-R (5' TGY GAG ATR ATG CAG CGA CG 3'). β -tubulin was amplified using primers T1 and T22 and sequenced with the PCR primers and the internal primers T2 and T12 from O'Donnell & Cigelnik (1997). For some isolates it was necessary to amplify the *tef1*- α region in two fragments using the following primer combinations: EF1-728F /EF1-1199R and EF1-983F/ EF1-1567R (Carbone & Kohn 1999, Castlebury, unpubl. data, for primer 1199R 5' GGG AAG TAC CMG TGA TCA TGT 3', Rehner 2001). The *rpb2* gene could not be amplified for *P. convexum*, *P. euphorbiaceum*, and *P. pulchellum* CBS 170.69. In addition, β -tubulin could not be amplified for *P. pulchellum* CBS 170.69. For the purpose of determining taxonomic affinities of species previously described as *Cryptodiaporthe* or *Plagiostoma* but not congeneric with *P. euphorbiae* (type species), a region of the nuclear ribosomal large subunit (LSU) was amplified as described in Castlebury *et al.* (2002).

Phylogenetic analyses

Editing and alignment of DNA sequences were performed as described in Mejía *et al.* (2008). Individual genes were aligned separately and subsequently concatenated into a single alignment. Table 1 includes detailed information about the gene sequences including GenBank numbers. The concatenated sequence alignment includes β -tubulin (1584 bp), ITS (625 bp), *rpb2* (1212 bp), and *tef1*- α (1149 bp) for a total of 4570 bp and 45 isolates. The taxa included in this alignment represent 24 of the 25 accepted species of *Plagiostoma* with *Apiognomonina hystrix* and *A. veneta* as outgroup taxa. Outgroup selection was based on the sister relationship of the genus *Apiognomonina* with *Plagiostoma* as inferred by a three-gene phylogeny of the family *Gnomoniaceae* (Sogonov *et al.* 2008). Positions with ambiguous alignment were excluded from the analyses.

The concatenated alignment was partitioned by gene and codon position for β -tubulin, *rpb2*, and *tef1*- α using PAUP (Swofford 2002). The gene partitions were analysed for conflict with the partition homogeneity test (PHT) as implemented in PAUP (Swofford 2002) using the following settings: 100 homogeneity replicates, 10 random sequence addition replicates, and MULTREES off. Conflict among gene partitions was assessed by reciprocal bootstrap analyses (Reeb *et al.* 2004) using distance settings for each partition as

determined by Modeltest v. 3.7 (Posada & Crandall 1998) following the Bayesian Information Criterion (BIC).

Genes were first analysed individually and then as a combined alignment using maximum parsimony, Bayesian, and maximum likelihood analyses. Trees and bootstrap support of branches were estimated by MP analysis as in Sogonov *et al.* (2008) with all characters considered unordered with equal weight and an additional analysis with unordered characters weighted as follows: weight = 3 for first and second codon positions and weight = 1 for third codon position. Additionally, trees were estimated using Bayesian analysis with the program MrBayes v. 3.1.2 (Huelsenbeck & Ronquist 2001) as described in Sogonov *et al.* (2008) with sampling every 500 generations. Model settings for each gene were determined using the program MrModeltest v. 2 (Nylander 2004) and selected based on the Akaike Information Criterion (AIC). The first 50 000 generations were discarded (burn-in period) based on comparison of tree likelihood scores. A 50 % majority rule consensus tree and a consensus phylogram were constructed from the trees saved after the burn-in period. The Bayesian posterior probabilities (PP) of nodes of the consensus trees are presented in Fig. 1. Trees were also estimated by Maximum Likelihood (ML) analysis using the program PAUP (Swofford 2002) as described in Sogonov *et al.* (2008) with Modeltest v. 3.7 (Posada & Crandall 1998) used to estimate the best model for the concatenated alignment. Maximum likelihood bootstrap analysis was not conducted.

RESULTS

Collection of specimens

The following plant species are reported as new hosts for species of *Plagiostoma*: *Alnus tenuifolia*, *Salix dasyclados*, *S. humboldtiana*, *S. irrorata*, *S. lucida*, and *S. sitchensis* (Table 1). *Plagiostoma pulchellum* from Argentina and *P. yunnanense* from southwestern China were collected in regions where no species of *Plagiostoma* had been previously reported.

Phylogenetic analyses

The partition homogeneity test suggested conflict among the four genes (ITS, *rpb2*, *β-tubulin*, and *tef1-α*) sequenced for this study ($P = 0.01$) with *rpb2* as the source of this conflict. For combinations of the remaining three genes (ITS, *β-tubulin*, and *tef1-α*), no incongruence among gene trees was detected when all three were analysed ($P = 0.09$), with $P = 0.07$ for ITS and *β-tubulin* and $P = 0.24$ for ITS and *tef1-α*. The following are the likelihood settings estimated for each gene for the reciprocal NJ bootstrap analyses: ITS: Base = equal Nst = 2 TRatio = 2.5434 Rates = equal Pinvar = 0.8337; *rpb2*: Base = equal Nst = 6 Rmat = (1.0000 4.6961 1.0000 1.0000 13.3827) Rates = gamma Shape = 0.2029 Pinvar = 0; *β-tubulin*: Base = (0.2006 0.3249 0.2505) Nst = 2 TRatio = 2.1757 Rates = gamma Shape = 0.5017 Pinvar = 0; and *tef1-α*: Base = (0.1918 0.3110 0.2229) Nst = 2 TRatio = 1.8586 Rates = gamma Shape = 0.6109 Pinvar = 0.

The ITS, *β-tubulin*, and *tef1-α* trees individually resolved terminal clades for most of the species analysed. Trees for each gene are provided - see online Supplementary Information. No single gene analysis resolved all the species of *Plagiostoma* with bootstrap support higher than 70 %. The following numbers of species were resolved by genes with bootstrap > 70 %: ITS = 11, *rpb2* = 9,

β-tubulin = 12, and *tef1-α* = 11. In general, *rpb2* was not as useful for resolving clades of closely related species as the other three genes. The ITS gene resolved and supported all terminal clades except *P. amygdalinae* and *P. euphorbiaceae* for which the sequences were nearly identical. However, it did not support backbone nodes at levels greater than 70 %. In contrast, bootstrap support greater than 90 % for all backbone nodes containing two or more species was obtained in the *β-tubulin*, *rpb2*, and *tef1-α* gene trees. The topology of the individual gene trees differed only slightly. One topological conflict supported by bootstrap values greater than 70 % was observed between the *β-tubulin* analysis resulting in a clade (97 %) that included all species of *Plagiostoma* on *Salicaceae* and the *rpb2* analysis resulting in a clade (72 %) that included some but not all the species on *Salicaceae* with some species on other hosts.

Phylogenetic trees resulting from the combined four-gene dataset (ITS, *β-tubulin*, *rpb2*, and *tef1-α*) were compared with those resulting from the ITS, *β-tubulin*, *tef1-α* dataset found to be conflict-free by the PHT. Maximum parsimony analyses of the four-gene combination resulted in 114 equally parsimonious trees (length = 1713, CI = 0.689, RI = 0.809) for the unweighted analysis and 42 equally parsimonious trees (length = 2062, CI = 0.689, RI = 0.807) for the weighted analysis. Fifty percent majority rule consensus trees computed for each analysis did not differ in the terminal species clades but higher bootstrap support was obtained for several clades in the weighted analysis. Maximum parsimony analysis of the three-gene combination composed of ITS, *β-tubulin*, and *tef1-α* resulted in eight equally parsimonious trees (length = 1275, CI = 0.707, RI = 0.817). The tree topologies obtained by MP analyses of the two alignments did not contradict each other; however, bootstrap support for several nodes increased in analyses of the four-gene combination. Therefore, subsequent analyses were performed on the four-gene combination.

The following models were the best estimates for each gene and were applied during the Bayesian analyses: HKY + I + G for ITS and *tef1-α*, SYM + G for *rpb2*, and HKY + G for *β-tubulin*. The model TrN+G was estimated to be the best for the entire alignment by both hLRT and BIC and those settings were applied to the maximum likelihood analysis: Base = (0.2245 0.2859 0.2454) Nst = 6 Rmat = (1.0000 3.5234 1.0000 1.0000 5.8336) Rates = gamma Shape = 0.2849 Pinvar = 0. Bayesian, ML, MP, and weighted parsimony (WP) analyses of the four-gene alignment all resulted in the same topology. Maximum likelihood analysis of the concatenated alignment of four genes resulted in one tree -lnL score of 13921.12887 and is presented as the inferred phylogeny of *Plagiostoma* (Fig. 1). Bayesian PP and MP bootstraps are shown above and below the branches. This phylogeny of *Plagiostoma* supports the recognition of eight new species, which are described in the taxonomic section of this work. Bayesian PP and MP bootstrap supports greater than 90 % were obtained for all the species of *Plagiostoma* in this multigene phylogeny. *Plagiostoma euphorbiae-verrucosae* is not included in the multigene phylogeny as only the ITS was available for this species. This species was confirmed as belonging in *Plagiostoma* by analysis of ITS sequences (tree not shown).

Evaluation of clades and species

Both Bayesian analysis and MP bootstrapping support a clade containing 11 species that occurs exclusively on hosts of the family *Salicaceae*. All of these species occur on the bark of twigs and branches with one species, *Plagiostoma versatile*, also occurring in the leaf midvein and petioles. Within the species on *Salicaceae*,

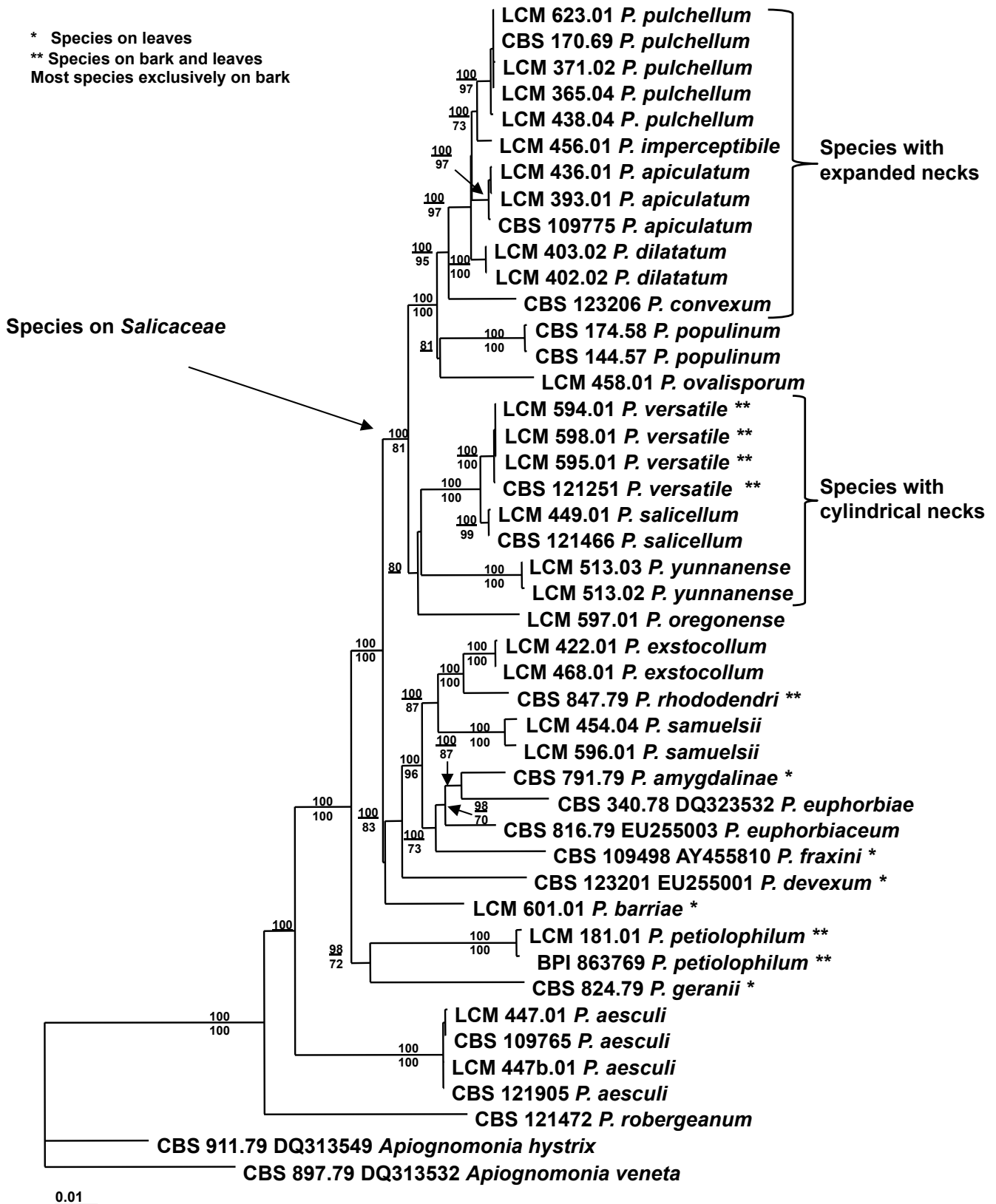


Fig. 1. Maximum likelihood phylogenetic tree (ML score = -lnL 13921.12887) estimated from sequences of the β -tubulin, ITS, *rpb2*, and *tef1- α* genes for 24 species of *Plagiostoma* and two species of *Apiognomonia*. Bayesian posterior probabilities greater than 80 % are shown above each branch and maximum parsimony bootstrap values greater than 70 % are shown below branches. Trees for each gene were also generated; see online Supplementary Information.

one clade consists of four closely related species characterised by having an expanded perithecial neck: *P. apiculatum*, *P. dilatatum*, *P. imperceptibile*, and *P. pulchellum*. These species are distinguished by morphological features such as perithecium size, ascospore size and length-to-width (l : w) ratio, and hyphal colour in culture. *Plagiostoma imperceptibile* is characterised by having ascospores longer than 18 μ m but with a length-width ratio (l : w) less than five. *Plagiostoma*

pulchellum is characterised by having ascospores with a l : w greater than five and by producing rosy-coloured hyphae that become dark green on PDA. *Plagiostoma apiculatum* and *P. dilatatum* are similar to one another but the perithecia and ascospores of *P. dilatatum* are larger than those of *P. apiculatum*. *Plagiostoma convexum* with a moderately expanded perithecial neck is highly supported (> 95 % MP, PP) as basal to these four species.

Plagiostoma ovalisporum and the pathogenic species *P. populinum* are closely related and contained within a larger clade including the five species previously mentioned (100 % MP, PP). The remaining species of *Plagiostoma* on *Salicaceae* form a weakly supported clade sister to the species on *Salicaceae* with expanded necks mentioned above. This clade contains three species having cylindrical, usually elongated, perithecial necks, and elongated ascospores: *P. salicellum*, *P. versatile*, and *P. yunnanense*. The remaining member of this clade, *P. oregonense*, is characterised by short, expanded perithecial necks and short ascospores.

Bayesian PP and MP bootstrapping also support a clade (83 % MP, 100 % PP) of eight species with hosts representing a range of woody and herbaceous plant families. One of the subclades in this group is composed of three species that grow on *Euphorbiaceae*: *P. amygdalinae*, *P. euphorbiaceum*, and *P. euphorbiae*, type species of the genus. Basal to these species is *P. fraxinum* on *Fraxinus pennsylvanica*. A second subclade contains *P. exstocollum* and *P. samuelsii* both on betulaceous hosts and *P. rhododendri* on *Rhododendron*. The rest of the species included in the tree, namely *P. aesculi*, *P. barriarum*, *P. geranii*, *P. petiophilum*, and *P. robergeanum*, are relatively distant from one another and the species previously mentioned. *Plagiostoma robergeanum*, a species that grows on *Staphylea* (*Staphyleaceae*) in Europe, was basal to the other species of *Plagiostoma*.

Specimens of *P. pulchellum* were collected in Europe, North America (USA), and South America (Argentina). This species is recognised as the most widely distributed species of *Plagiostoma* included in this study and is presented here as the first report of *Gnomoniaceae* for South America. *Plagiostoma yunnanense* is the first report of *Plagiostoma* for China.

DISCUSSION

Due to the morphological diversity in species of *Plagiostoma*, as illustrated in Figs 2–6, no single morphological character is unique or diagnostic for this genus. The following morphological characters differentiate *Plagiostoma* from other genera of the *Gnomoniaceae* as defined by Sogonov *et al.* (2008, table 2). Unlike *Gnomonia*, species of *Plagiostoma* have perithecia that often collapse from the base when dry as illustrated in Sogonov *et al.* (2008, fig. 43 B–C). In *Plagiostoma* the neck length is short to long about equal or less than the diameter of perithecia, while in *Ophiognomonia* the perithecial neck length is usually very long, often pointed, and 2.5–5 times the perithecial diameter. Species of *Ophiognomonia* occur only on leaves while those of *Plagiostoma* are found on leaves as well as woody tissues. Except for *P. rhododendri*, the ascospores of *Plagiostoma* are not broader at the upper part as in *Gnomoniopsis*. Ascospores of *Plagiostoma* are never cylindrical or femuroid as in *Cryptosporella*. Species of *Plagiostoma* with ellipsoid, aseptate ascospores similar to those of *C. hypodermia* do not have a valsoid arrangement of perithecia as do species of *Cryptosporella*.

Species of *Plagiostoma*, except for *P. rhododendri*, are not apiosporous, differentiating them from species of *Apiognomonia* except *A. hystrix*, which possesses flattened perithecial necks. Species of *Pleuroceras* have elongated ascospores that are quite distinct from those of *Plagiostoma*. The type and only species of *Ditopella*, *D. ditopa*, is characterised by having polysporic asci. *Phragmoporthes conformis*, a species closely related to *Ditopella ditopa*, is characterised by phragmosporic ascospores, a character not present in *Plagiostoma*. The perithecia of *Amphiporthes*

hranicensis, the type species of *Amphiporthes*, are grouped near the base of the entostroma and, thus, are different from those found in *Plagiostoma*. In addition, *Amphiporthes hranicensis* produces perithecia in clusters of up to 20, with perithecial necks protruding as a group from the host periderm and surrounded by gray stromatic tissue.

Perithecial neck characters and ascospore morphology are the most important characters for differentiating *Plagiostoma* from other genera in the *Gnomoniaceae*. Host identity, geographic locality, and presence or absence of stroma are secondary characters for the identification of species. For example, the presence of white stromatic tissues surrounding the emerging perithecial necks is diagnostic in species such as *P. aesculi*, *P. salicellum*, and *P. samuelsii*. Within *Plagiostoma* perithecial neck shape ranges from very short, cylindrical to expanded and thick or thin, cylindrical and elongated with various shapes in the opening area, *e.g.* conic, flared, or rounded. In one species, *P. versatile*, the perithecial neck can be both very short when on twigs or elongated when on a leaf midvein suggesting that this structure varies with substrate. Four species, *P. apiculatum*, *P. convexum*, *P. dilatatum*, and *P. imperceptibile*, are characterised by having an apically expanded perithecial neck. The expanded neck was noticed by Wallroth (1833, as *coronatum dilatatis*) and Butin (1958, as cushion- or pad-like structure) but neither of these authors used this character to differentiate species. This structure may be involved in rupture of host periderm and release of the ascospores.

The asci of *Plagiostoma* are clavate, obclavate, ovoidal, cylindrical, or cylindrical-fusoid, generally with a short stalk but with a long stalk in *P. imperceptibile*. Ascospores of *Plagiostoma* are ellipsoid, ellipsoid-fusoid, oblong-ellipsoid, or ovoid usually with one median septum, although three species, *P. euphorbiae-verrucosae*, *P. fraxini*, and *P. ovalisporum*, have non-septate ascospores and one species, *P. rhododendri*, is apiosporous. Ascospores vary in size from short, 7.7–13.8 × 2.2–6.6 µm in *P. fraxini*, to relatively long, 18–27 × 3–4 µm in *P. versatile* and *P. yunnanense*. Most species lack appendages although *P. salicellum* has short, thick, evanescent appendages and *P. devexum* and *P. samuelsii* may have long, thin appendages. Morphological characters that are phylogenetically informative for subclades of *Plagiostoma* include the expanded neck characteristic of species with broadly ellipsoid ascospores versus the cylindrical neck characteristic of species with narrowly ellipsoidal ascospores.

In traditional classification schemes of the *Diaporthales*, *Cryptodiaporthes* and *Plagiostoma* were considered distinct and not closely related genera, each with a specific morphology and arrangement of perithecia (Barr 1978, Kobayashi 1970, Monod 1983). Species of *Plagiostoma* were characterised by the lack of a stroma and production of a single perithecium, primarily on leaves. Species of *Cryptodiaporthes* were characterised by production of a rudimentary stroma and grouped perithecia, primarily in the bark of their host branches. The differences between *Cryptodiaporthes* and *Plagiostoma* have been emphasised such that some authors placed them in different families or subfamilies (Barr 1978, Wehmeyer 1975).

Monod's (1983) concept of *Plagiostoma* differed significantly from the concept presented here. Of the 13 species treated by Monod (1983) as *Plagiostoma*, only *Plagiostoma devexum* is accepted here in that genus. Of the 13 species of *Plagiostoma* accepted by Sogonov *et al.* (2008), only *P. euphorbiae* and *P. devexum* were originally described as *Plagiostoma* with *Plagiostoma barriarum* newly described in that work. *Plagiostoma aesculi* and *P. salicellum* were previously regarded by Wehmeyer (1933) as *Cryptodiaporthes*. Four

additional species of *Cryptodiaporthe* are here formally combined in *Plagiostoma*, namely *P. apiculatum*, *P. convexum*, *P. populinum*, and *P. pulchellum*. The recognition of these four species formerly classified as *Cryptodiaporthe salicina* broadens the range of morphological and ecological traits of the genus *Plagiostoma*. The pathogenic species, *P. apiculatum*, *P. fraxini*, and *P. populinum*, contrasts with the concept of *Plagiostoma* as primarily saprobic.

The economically important species of *Plagiostoma* are pathogens that cause cankers on willows and poplars. *Plagiostoma apiculatum* (synonym *Cryptodiaporthe salicella*) is here determined to be the correct name for the fungus causing a canker disease of willow (Sinclair & Lyon 2005). This species, referred to by the anamorph *Diplodina microsperma*, has been reported as the most abundant endophyte in healthy twigs of *Salix fragilis* in England (Petrini & Fisher 1990) and is thus an important component of the host microbiota. Similarly, the closely related species *P. dilatatum*, *P. imperceptibile*, and *P. pulchellum* form a black halo or spot on the host surface, a feature that may be associated with the early stages of canker development. Whether or not these species are primarily pathogenic or establish an asymptomatic infection that later develops into cankers needs to be determined. These

species form a highly supported monophyletic group (Fig. 1) characterised by having an expanded perithecial neck and broad ellipsoid to renoid ascospores. This group of species is part of a larger, highly supported clade that also includes *P. convexum*, *P. ovalisporum*, and *P. populinum* (synonym *Cryptodiaporthe populea*), the pathogen causing a canker of poplars. *Plagiostoma fraxini* causes anthracnose on ash (*Fraxinus pennsylvanica*) and fringetree (*Chionanthus retusus*) (Gregory *et al.* 2004, Sinclair & Lyon 2005), and is sister to the clade containing three species on *Euphorbiaceae*.

Species of *Plagiostoma* occur on a broad range of host plant families within the Eudicots, although most species are associated with Rosids. This study shows an association between a clade composed of 11 species of *Plagiostoma* and the host family *Salicaceae* (Fig. 1) especially on the genus *Salix*. Most of the species of *Plagiostoma* on *Salix* have expanded necks. These findings agree with those for other genera within the *Gnomoniaceae* that are associated primarily with specific host genera in the *Betulaceae* such as *Cryptosporella* on *Alnus* and *Betula* (Mejía *et al.* 2008) and *Gnomonia* on the *Coryloideae* (Sogonov *et al.* 2008).

TAXONOMY

KEY TO SPECIES OF *PLAGIOSTOMA*

1. Ascospores non-septate 2
- 1'. Ascospores 1-septate 4
2. Ascospores ovoid, (12–)14–16(–17) × 7–8(–9) µm. On twigs of *Salix* sp., in North America (USA: ID) *P. ovalisporum*
- 2'. Ascospores ellipsoid-fusoid. Not on *Salix*, in Europe and North America 3
3. Ascospores 20–25.5 × 5.3–6 µm *fide* Monod (1983), with pointed ends. On *Euphorbia*, in Europe *P. euphorbiae-verrucosae*
- 3'. Ascospores (7.7–)8.6–12.7(–13.8) × (2.2)2.8–5.9(–6.6) µm *fide* Redlin & Stack (1988). On *Chionanthus* and *Fraxinus* (*Oleaceae*), in Canada and USA *P. fraxini*
4. On *Salicaceae* 5
- 4'. On hosts other than the *Salicaceae* 14
5. Perithecia neck cylindric. On woody substrates except *P. versatile*, which occurs on both leafy and woody substrates 6
- 5'. Perithecial neck dilated *i.e.* with an expanded or thickened area that appears disk-like when seen from above, like a thick collar in section, usually appearing with a black halo or black spot in host surface where perithecial necks protrude. On woody substrates 10
6. Perithecial neck surrounded by a whitish stroma. On *Salix*, in Europe *P. salicellum*
- 6'. Perithecial neck without a whitish stroma. On *Salix* or *Populus*, in Europe and elsewhere 7
7. On twigs and branches of *Populus*, in Europe and North America (USA). Ascospores 14–16 × 6–9 µm *fide* Butin (1958) *P. populinum*
- 7'. On twigs and branches of *Salix*, in China, Europe, and North America. Ascospores greater than 16 µm long 8
8. Ascospores ellipsoid-fusoid, constricted, curved, tapering to acute ends, (16–)18–20 (–22) × 4–5 µm. In Europe and North America (USA: NY) *P. convexum*
- 8'. Ascospores ellipsoid-elongated, slightly constricted, straight to slightly curved, rounded ends, generally longer than 20 µm. In China or North America 9
9. Perithecial neck slightly twisted in upper half, of constant length. Ascospores (19–)23–26(–27) × 3–4 µm. On *Salix* sp., in China (Yunnan) *P. yunnanense*
- 9'. Perithecial neck straight, of variable length, very short in twigs, longer in leaves. Ascospores (18–)20–23(–25) × 3–4 µm. On *Salix* spp., in North America (Pacific Northwest region). *P. versatile*

10. Ascospores ellipsoid to broadly ellipsoid, constricted, tapering to narrowly rounded ends, (16–)17–19(–22) × (4–)6(–7) μm.
On *Salix*, in North America (USA: OR) *P. oregonense*
- 10'. Ascospores oblong-ellipsoid to renoid, not or slightly constricted, rounded ends, size different than above. On *Populus* and *Salix*,
in North America and elsewhere 11
11. Ascospores usually straight, sometimes slightly curved, l : w > 5, (17–)18–22(–27) × (5–)6–7(–7.5) μm. On *Populus* and *Salix*,
in Europe, North and South America (Argentina) *P. pulchellum*
- 11'. Ascospores slightly curved, l : w < 5. On *Salix* spp., in Europe and North America 12
12. Asci ovoid elongated, with long, usually persistent stalk. Ascospores (18–)19–20(–21) × (5–)6–7(–8) μm, l : w (2.5–)2.9–3.1(–3.8).
On *Salix* sp., in North America (USA: CA) *P. imperceptibile*
- 12'. Asci cylindrical, often with long but not persistent stalk. Ascospores averaging < 18 μm long. In Europe and North America 13
13. Ascospores (12–)13–15(–22) × 4–5(–7) μm, mean = 15 × 5 μm, l : w (2.6–)3.0–3.3(–3.8). On *Salix*, in Europe (France) *P. dilatatum*
- 13'. Ascospores (12–)16–18.5(–21) × (3–)5–6(–7) μm, mean = 17 × 6 μm, l : w (2.4–)2.9–3.2(–4.0). On *Salix*, in Europe and
North America *P. apiculatum*
14. On hosts in the *Euphorbiaceae* 15
- 14'. On hosts other than *Euphorbiaceae* 17
15. On leaves of *Euphorbiaceae*, specifically *Euphorbia amygdaloides* and *E. stepposa*. Ascospores 13–15.5 × 2.3–3 μm *fide* Monod
(1983 as *Gnomonia amygdalinae*), with a thin appendage at each end *P. amygdalinae*
- 15'. On twigs, branches, or stems of the *Euphorbiaceae*. Ascospores without appendages 16
16. Perithecial neck less than 100 μm. Ascospores (12–)13–13.5(–15.5) × (3–)3.5(–4) μm *fide* Sogonov *et al.* (2008) *P. euphorbiae*
- 16'. Perithecial neck 100–150 μm. Ascospores 14–17.5 × 3.5–4.5 μm *fide* Monod (1983 as *Gnomonia euphorbiacea*) *P. euphorbiaceum*
17. On *Acer* 18
- 17'. On hosts other than *Acer* 19
18. On leaves, twigs, and branches of *Acer* spp., in the Pacific Northwest region of USA.
Ascospores (11.5–)14–15.5(–17.5) × (2.5–)3.5–4(–4.5) μm *fide* Sogonov *et al.* (2008) *P. barriiae*
- 18'. On leaves, twigs, and branches of *Acer saccharum* and *A. spicatum*, in eastern USA and Canada. Ascospores 7–12 × 1–2.5 μm
fide Barr (1978) *P. petiophilum*
19. Ascospores with thin, deliquescent appendages 20
- 19'. Ascospores without appendages 21
20. Necks eccentric, stout, cone-shaped, surrounded by a whitish stroma. Ascospores (10–)11–12(–19) × 3–4 μm.
On *Alnus* spp., in the Pacific Northwest region of USA *P. samuelsii*
- 20'. Necks marginal, cylindrical, without whitish stroma. Ascospores 8–10 × 2–3 μm *fide* Monod (1983). On *Persicaria* and *Polygonum*,
rarely on *Rumex* and *Vitis*, in Europe and USA (NY) *P. devexum*
21. Ascospore upper cell rounded, basal cell short-conic, 13–16 × 4–5 μm/12–16 × 5–7 μm *fide* Monod 1983 & Remler 1979 as
Apiognomonia rhododendri. In pedicels and branches of *Rhododendron* spp., in Europe *P. rhododendri*
- 21'. Ascospores not as above 22
22. In dead stems of herbaceous plants, specifically *Geranium* spp., in Europe. Ascospores 13–18 × 1.8–2.5 μm
fide Monod (1983) *P. geranii*
- 22'. In twigs and branches of woody plants, in Europe or North America 23
23. Perithecia in groups, with necks closely appressed as a mass emerging together or in a row, surrounded by a white stroma.
On *Aesculus hippocastanum*, in Europe *P. aesculi*
- 23'. Perithecia in groups or solitary, with necks emerging together or not, surrounded or not by a brownish stroma.
On hosts other than *Aesculus hippocastanum*, in Europe or North America 24
24. Stroma brownish, covering perithecia but not surrounding necks. Perithecia arranged in groups, with necks emerging together but
oriented in different directions where they protrude through host epidermis. On *Corylus californica*, in the Pacific Northwest region of
USA *P. exstocollum*
- 24'. Stroma absent. Perithecia solitary or in groups with convergent, protruding necks. On *Staphylea*, in Europe *P. robergeanum*

DESCRIPTIONS

Plagiostoma Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 118. 1870.

Lectotype designated by Höhnel (1917): *Plagiostoma euphorbiae* (Fuckel) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 118. 1870.

= *Cryptodiaporthe* Petr., Ann. Mycol. 19: 118. 1921. Lectotype designated by Clements and Shear (1931): *Cryptodiaporthe aesculi* (Fuckel) Petr., now *Plagiostoma aesculi* (Fuckel) Sogonov, Stud. Mycol. 62: 69. 2008.

= *Rostrocoronophora* Munk, Dansk Bot. Arkiv 15: 98. 1953. Type: *R. geranii* (Hollós) Munk, now *Plagiostoma geranii* (Hollós) Sogonov, Stud. Mycol. 62: 72. 2008.

Anamorph: *Diplodina* Westend., Bull. Acad. Roy. Sci. Belgique, sér. 2, 2: 562. 1857.

Anamorph type species: *Diplodina salicis* Westend., Bull. Acad. R. Sci. Belg., Cl. Sci., sér. 2 12(7) (1857), now recognised as *Diplodina microsperma* (Johnst.) B. Sutton, Mycol. Pap. 141: 69. 1977 fide Sutton (1980).

Perithecia produced in dead, fallen or still attached host organs, immersed in bark of stems, branches, and twigs, in midvein or petiole of leaves (*P. fraxini* on leaf lamina), on stalks of herbaceous plants, and on peduncles (*P. rhododendri*). Most species initially appearing as conic-shaped or rounded elevations, usually 0.2–0.5 mm high × 1–2 mm diam, produced where a single perithecium or group of perithecia push up host surface from below. Perithecial necks protrude through epidermis or periderm making a small hole or slit, with perithecia partially or completely exposed by peeling host periderm. In bark, perithecia arranged in groups or solitary, scattered, numerous; in leaves, perithecia discrete, but growing close together. *Stroma* scanty, flocculose, gray, brownish, cream, yellowish white, or whitish. *Perithecia* black, globose, slightly flattened or suboblate, usually collapsed from base when dry, with or without stromatic tissue surrounding neck. *Neck* central to marginal, mostly cylindrical, also flattened, short and stout, upright, straight or contorted, or slanted and straight; 30–150 µm diam not including expanded area, with or without a disk-like expansion, up to 450 µm diam; apex rounded, acute, flared, cupulate, papillate, or conic, black, brown, yellow or hyaline, with or without furrows. *Asci* clavate, obclavate, ovoidal to cylindrical and cylindric-fusoid, usually with a short stalk, with a long stalk in *P. imperceptibile*, with a conspicuous apical ring that may appear single and thick or as two refractive bodies, eight ascospores arranged obliquely parallel, biseriate, multiseriate, or twisted. *Ascospores* ellipsoid, ellipsoid-fusoid, oblong-ellipsoid, ovoid, hyaline, non- or 1-septate, constricted or not at median to submedian septum, apiosporous in *P. rhododendri*, often with four or more rounded guttules, or appearing granulated, with or without an appendage at each end. Cultures of *Plagiostoma* generally grow moderately (4 cm) to fast (5–6 cm) diam after 7 d on PDA, velvety, granular, with concentric halo, with scant aerial mycelium, translucent, white, pale to very dark gray, hazel, dark green, olive or with various dark yellow to orange pigmentation, margins fringed, stringed, or root-like.

Species of *Plagiostoma*

Plagiostoma aesculi (Fuckel) Sogonov, Stud. Mycol. 62: 69. 2008.

Basionym: *Cryptospora aesculi* Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 193. 1870.

= *Cryptosporella aesculi* (Fuckel) Sacc., Michelia 1: 30. 1877.

[= *Diaporthe aesculi* (Fuckel) Höhn., Ann. Mycol. 16: 116. 1918, nom. illeg. non Cooke & Harkn. 1881]

= *Cryptodiaporthe aesculi* (Fuckel) Petr., Ann. Mycol. 19:119. 1921.

Note: Sogonov *et al.* (2008) provided a description and illustrations of this species. Cultures are illustrated here in Fig. 7A–B.

Specimen examined: **Germany**, Langen, on branches of *Aesculus hippocastaneum*, L.C. Mejía, BPI 878950, culture LCM 447.01 = CBS 126127.

Plagiostoma amygdalinae (Fuckel) Sogonov, Stud. Mycol. 62: 70. 2008.

Basionym: *Gnomonia amygdalinae* Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 121. 1870.

= *Gnomoniella amygdalinae* (Fuckel) Sacc., Syll. Fung. 1: 418. 1882.

= *Gnomoniella amygdalinae* f. *euphorbiae-stepposae* Sandu, Stud. Cercet. Biol., Bot. 18: 18. 1966 fide Monod (1983).

Note: Monod (1983) provided a detailed description of this species as *Gnomonia amygdalinae*. Although ITS sequences of *P. amygdalinae* (Monod 207 = CBS 791.79) and *P. euphorbiaceum* (MS196 = CBS 121241, Monod 465 = CBS 816.79) suggest that these taxa are the same, the multigene phylogeny obtained here reveals that *P. amygdalinae* and *P. euphorbiaceum* are distinct species. *Plagiostoma amygdalinae* occurs on leaves and has a longer and thinner perithecial neck, shorter asci, thinner apical ring, and ascospores not constricted at septum and thinner than *P. euphorbiaceum* that occurs on twigs, stems, and branches (also see Monod 1983).

Plagiostoma apiculatum (Wallr.) L.C. Mejía, **comb. nov.** MycoBank MB515689. Figs 2A–J, 7C–F

Basionym: *Sphaeria apiculata* Wallr., Fl. Crypt. Germ. 2: 778. 1833.

= *Metasphaeria apiculata* (Wallr.) Sacc., Syll. Fung. 2: 166. 1883.

= *Gnomonia apiculata* (Wallr.) G. Winter, Rabenh., Kryptog.-Fl., ed. 2, vol. 1(2): 589. 1887.

= *Diaporthe spina* Fuckel var. *apiculata* (Wallr.) Rehm, Ann. Mycol. 7: 404. 1909.

= *Cryptodiaporthe apiculata* (Wallr.) Petr., Ann. Mycol. 19: 177. 1921.

Anamorph: *Diplodina microsperma* (Johnst.) B. Sutton, Mycol. Pap. 141: 69. 1977.

Perithecia immersed in bark, solitary, scattered, appearing initially as slight punctiform elevations of periderm surrounded by a black halo with tip of neck protruding through slit, usually with three short radiating slits, halo paler in some collections, later becoming completely black, globose, (223–)252–364(–440) µm high × (349–)370–476(–477) µm diam (mean = 314 × 429 µm, SD 59, 77, n = 8), each with one neck. *Neck* central to eccentric, straight to oblique, with a pale brown papilla, with an expanded area that appears disk-like, sometimes evident only as a thick neck, initially below epidermis, becoming exposed, producing a black halo at surface, (115–)159–256(–351) µm long (mean = 208, SD 78, n = 8), expanded area (187–)224–340(–389) µm diam (mean = 284, SD 74, n = 8), (62.5–)81–128(–134) µm diam at apex (mean = 104, SD 29, n = 7). *Asci* cylindrical, (45–)51–80(–86) × 10–16(–18) µm (mean = 68 × 13, SD 15, 4, n = 19), apical ring 2.5–5.0 µm diam, variable in shape e.g. elongated as two bodies or hexagonal, with eight ascospores arranged biseriate to multiseriate. *Ascospores* oblong-ellipsoid, slightly tapering to rounded ends, straight to slightly curved, one median to submedian septum, not constricted, (12–)16–18.5(–21) × (3–)5–6(–7) µm (mean = 16.5 × 5.5, SD 2.5, 1.0, n = 106), l : w (2.4–)2.9–3.2(–4) (mean = 3.0, SD 0.3, n = 106), with granular cytoplasm.

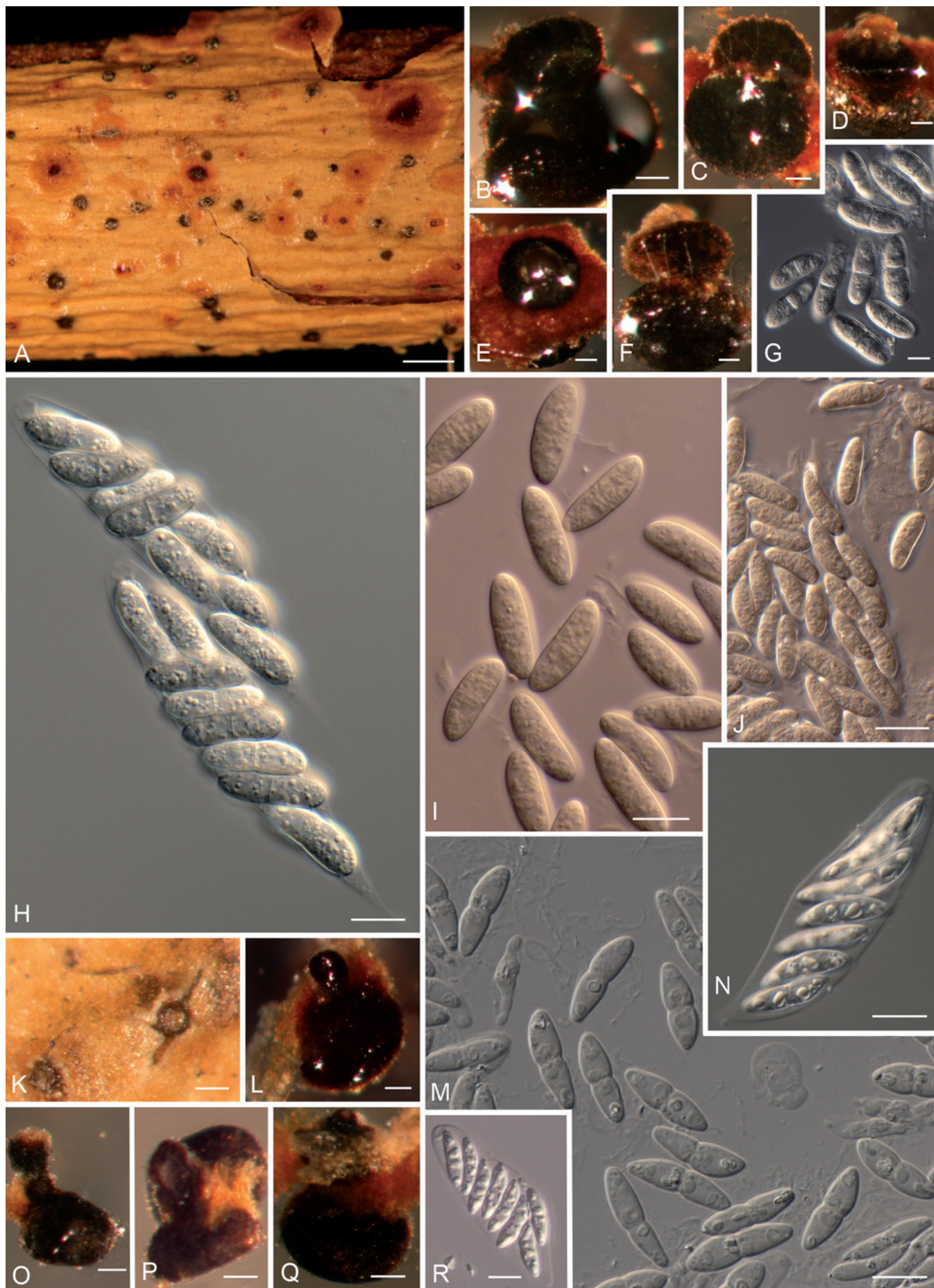


Fig. 2. Morphology on natural substrate. A–J: *Plagiostoma apiculatum*: A, B, I, J = BPI 799002 (lectotype), C–G = BPI 747938 (epitype), H = BPI 878952. K–R: *P. convexum*: K–M = BPI 799418 (lectotype), L–R = BPI 843490 (epitype). Bars = (A, K) 1 mm; (B–F, L, O–Q) 100 μ m; (G–J, M–N, R) 10 μ m.

Cultures: Moderate to fast growth on PDA after 7 d a.c.d. 5 cm (SD 0.4, n = 4), thin aerial mycelium of velvety granular texture, central area vinaceous buff 45, with scattered black mycelial clumps of 0.5 mm diam in central area, margin white, stringy; reverse similar but slightly darker.

Habitat and host: On dead twigs and branches of *Salix* spp., *Salix alba*, *S. alba* subsp. *vitellina*, *S. dasyclados*, and *S. sitchensis* (*Salicaceae*).

Distribution: Europe and North America.

Lectotype of *Sphaeria apiculata* designated here: BPI 799092, labelled *Sphaeria apiculata* Wallr., ex. Herb. Strasbourg.

Epitype of *Sphaeria apiculata* designated here: Austria, Vienna, 21st district, Marchfeldkanalweg, MTB 7764/1, on *Salix* sp., 20 May 2000, W. Jaklitsch 1463, BPI 747938, derived culture CBS 109775 = AR3455.

Exsiccatum examined: Fungi Rhenani 918, as *Sphaeria apiculata*, from *Salix vitellina*, BPI bound.

Additional specimens examined: Austria, Vienna, St. Margareten im Rosental, Kaernten, Drau-Auen, 9452/1, on *Salix alba*, 2 May 2002, W. Jaklitsch 1890, BPI 843511, derived culture AR 3826; St. Margareten im Rosental, Drau-Auen, Kaernten, 9452/2, on *Salix alba*, 14 Apr. 2001, W. Jaklitsch 1741, BPI 872037. France, Deux-Sèvres Département, Melle, Melle Arboretum, 15 Apr. 2008, on twigs of *Salix dasyclados*, L.C. Mejia 393, BPI 878951, derived cultures L.C. Mejia 393.01 and CBS 124974 = LCM393.03. USA, Washington, Kitsap County, Kitsap Memorial State Park, on twigs of *Salix sitchensis*, 28 May 2008, L.C. Mejia 436, BPI 878952, derived culture CBS 126126 = LCM436.01.

Notes: The specimen designated here as lectotype is part of the collection of *Sphaeria apiculata* referred to in the protologue. It agrees with Wallroth's description of *S. apiculata*. Fuckel (1870) recircumscribed *Sphaeria apiculata* Wallr. based on Fungi Rhenani 918. The original Latin description of *Sphaeria apiculata* includes morphological characters of the perithecia such as an apiculate papilla, i.e. "*coronatum dilatatis*", here interpreted as the disk-shaped expansion of the perithecial neck, and "*nucleo atro*" at the apex. These morphological characters are present in the type specimen BPI 799092 of *S. apiculata* designated here as the lectotype. The protologue of *S. apiculata* by Wallroth (1833) does not include a description of the ascospores, however, the fungus on this specimen contains broadly ellipsoid ascospores. This specimen and thus *Plagiostoma apiculatum* is distinctive and differs from *Plagiostoma salicellum* as discussed under that species.

The concept of the name *Sphaeria apiculata* has been confused. The following is an account of this species and its various synonyms based on the results of our study of the original description, type specimens, and relevant later specimens. Höhnel (1917), Petrak (1921), and later authors considered *Sphaeria apiculata* to have narrowly elongated ascospores while Wehmeyer (1933) recognised this species as having broadly ellipsoid ascospores and considered *Cryptodiaporthe salicina* to be a synonym. Höhnel (1917) examined specimens made by Rehm, Krieger, and his own of *Diaporthe spina* and considered this name to be a synonym of *Sphaeria apiculata*. He acknowledged differences in perithecial neck length among collections of these two species. To determine the synonymy of these two species we compared the original description of *D. spina* with the original description of *S. apiculata* by Wallroth (1833) as well as the recircumscription by Fuckel (1870). In his original

description of *D. spina* Fuckel (1870) provided a drawing that is quite unlike the original description of *S. apiculata*. Based on the comparison of descriptions and the specimens observed, we do not consider *S. apiculata* and *D. spina* to be synonyms. The synonymy of these two species proposed by Höhnel (1917) and accepted by Petrak's (1921) who provided a description of *Cryptodiaporthe apiculata* (\equiv *Sphaeria apiculata*) may be the reason that later authors considered *S. apiculata* to be characterised by narrow, elongated ascospores as described and observed for *D. spina*.

***Plagiostoma barriae* Sogonov, Stud. Mycol. 62: 69. 2008.**

Note: Sogonov *et al.* (2008) provided a description and illustrations of this species. Cultures of isolates used in this study are illustrated in Fig. 7G–H. Originally described from the state of Washington (USA), this species is here reported from Oregon.

Specimens examined: USA, Oregon, on *Acer* sp., coll. L.C. Mejia LCM 484.01, BPI 878953, derived culture CBS 126125 = LCM 484.01; Washington, on *Acer macrophyllum*, L.C. Mejia 601, BPI 87895, derived culture LCM 601.01.

***Plagiostoma convexum* (Preuss) L.C. Mejia, comb. nov.**
MycoBank MB515690. Fig. 2K–R.

Basionym: *Sphaeria convexa* Preuss, Linnea 26: 714. 1853.

\equiv *Diaporthe convexa* (Preuss) Sacc., Syll. Fung. 1: 630. 1882.

= *Cryptodiaporthe salicina* Wehm. as (Curr.) Wehm., The Genus *Diaporthe* Nitschke and its Segregates p. 194. 1933.

[\equiv *Sphaeria salicina* Curr., Trans. Linn. Soc. Lond., 22: 279, 1858 non *Sphaeria salicina* Pers., 1796]

\equiv *Diaporthe punctata* (Cooke) Berl. & Voglino, Syll. Fung., Add. 108. 1886.

Perithecia immersed in bark, solitary or in groups of up to four, appearing initially as slight conic elevation of periderm with apex protruding through a small hole, black, globose, (180–)213–258(–326) μ m high \times (282–)303–352(–415) μ m diam (mean = 238 \times 329, SD 38, 44, n = 13), each with one neck. Neck central to eccentric, cylindrical, thick, usually thicker toward apex, some thicker elsewhere on neck, upright, diagonally straight, or curved, closely appressed when in groups, (82–)161–204(–222) μ m long (mean = 176, SD 36, n = 13), (71–)82–104(–121) μ m diam at base (mean = 95, SD 16, n = 13), (64–)78–108(–128) μ m diam at apex (mean = 93, SD 21, n = 13), apex usually paler. Asci clavate, (54–)60–63(–69) \times (14–)15–18(–20) μ m (mean = 61 \times 17, SD 4.5, 2.2, n = 8) apical ring 3.0–4.0 μ m diam, with eight ascospores arranged obliquely parallel to multiseriate. Ascospores ellipsoid-fusoid, tapering toward rounded ends, curved or straight, one median to submedian septum, constricted, (16–)18–20(–22) \times 4–5 μ m (mean = 18.5 \times 4.5, SD 1.0, 0.4, n = 51), l : w (3.2–)3.9–4.5(–4.9) (mean = 4.2, SD 0.4, n = 51), with four refractive bodies of various shapes, often globose.

Habitat and host: On twigs of *Salix* spp.

Distribution: Germany, USA (New York).

Lectotype specimen of *Sphaeria convexa* designated here: *Sphaeria convexa* Preuss, without other data, ex. Herb. Brussels in Shear study collection types and rarities, BPI 799418.

Epitype specimen of *Sphaeria convexa* designated here: USA, New York, Tompkins Co., near Ithaca, Arnot Forest, on *Salix* sp., 12 Jul 2002, L. Vasilyeva, BPI 843490, derived culture CBS 123206.

Notes: *Plagiostoma convexum* as *Sphaeria convexa* was considered a synonym of *Cryptodiaporthe salicina* by Wehmeyer (1933). *Plagiostoma convexum* has ascospores that agree with those drawn by Wehmeyer (1933 as *C. salicina*, plate XIII, figs 3–5). In his description of *S. salicina*, Currey (1858) mentions that the septum in the sporidia (ascospores) is “often very difficult to make out”, but the ascospores in his drawing have a septum. The rest of his description agrees with the description of *S. convexa*. It also agrees with the lectotype specimen of *S. convexa*, BPI 799418 ex. Herb. Brussels with a note on the label saying apparently from Preuss). This evidence suggests that *S. salicina* Curr. 1858 and *S. convexa* Preuss 1852 represent the same species. Because *S. salicina* Curr. is a later homonym of *Sphaeria salicina* Pers. 1796, this basionym cannot be used and the next available epithet is *S. convexa*; hence the correct name for this taxon is *Plagiostoma convexum*. The specimen BPI 799418 is here designated the lectotype and the specimen BPI 843490 with the ex-epitype culture CBS 123206 is designated the epitype of *Sphaeria convexa*.

Wehmeyer (1933) listed 28 synonyms of *Cryptodiaporthe salicina*. Among specimens that Wehmeyer (1933) recognised under that name, Butin (1958) elaborated differences in ascospore morphology, conidial state, host, and ecological characteristics and distinguished three species: *C. apiculata* (Wallr.) Petr., *C. populea* (Sacc.) Butin, and *C. pulchella* (Sacc.) Butin, here accepted as *Plagiostoma apiculatum*, *P. populinum*, and *P. pulchellum*. Butin (1958) did not consider any of these species to be conspecific with *Sphaeria salicina* Curr. On the contrary he listed *Cryptodiaporthe salicina* based on *Sphaeria salicina* Curr. as a synonym of *Cryptodiaporthe salicella*, here recognised as *Plagiostoma salicellum*. Although Wehmeyer (1933) listed *Sphaeria sphingiphora* Oudem. 1873 [= *Diaporthe sphingiphora* (Oudem.) Sacc.] as a synonym of *C. salicella*, *S. sphingiphora* occurs on *Cornus*. It is unlikely to be the same species as *P. convexum*. *Diaporthe cupulata* Berl. & Destrée was considered a synonym of *Sphaeria convexa* by Wehmeyer (1933), however, the ascospore sizes of these species are different. We do not consider them to be synonymous. The specimen at BPI of *Sphaeria salicina* Pers., Scleromyceti Sueciae 10, was examined and determined to be a species of *Valsa*.

***Plagiostoma devexum* (Desm.) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 119. 1870.**

Basionym: *Sphaeria devexa* Desm., Pl. Cryptog. Nord. de France, Edit. II, Ser. II, No. 367. 1856.

= *Gnomonia devexa* (Desm.) Auersw. in Gonn. & Rabenh., Mycol. Europ. 5/6: 23. 1869.

= *Gnomoniella devexa* (Desm.) Sacc., Syll. Fung. 1: 417. 1881.

= *Gnomoniopsis devexa* (Desm.) Moesz & Smarods, Bot. Közlem. 38: 68. 1941.

= *Sphaeria excentrica* Cooke & Peck, Annual Rep. New York State Mus. 25: 105. 1873 fide Monod (1983).

= *Gnomoniella excentrica* (Cooke & Peck) Sacc., Syll. Fung. 1: 418. 1882.

= *Diaporthe sechalinensis* Sacc., Atti Del Congr. Bot. Di Palermo 1902: 52. 1902 fide Monod (1983).

= *Ceriosporella polygoni* A. L. Sm. & Ramsb., Trans. Brit. Mycol. Soc. 4: 325. 1914 fide Monod (1983).

Note: Barr (1978) and Monod (1983) provided detailed descriptions of this species.

***Plagiostoma dilatatum* L.C. Mejía, sp. nov.** MycoBank MB515700. Figs 3A–D, 7I–L.

Etymology: *dilatatum* - dilate; referring to the dilated or expanded area of the perithecial neck that appears disk-like when seen from above, and like a thick collar in section.

Perithecia globosa, (277–)320–442(–502) µm elata, (382–)475–572(–642) µm diametro; rostrum breve, apice punctatum, (152–)257–308(–327) µm longum, cum expansa area disciformi vertice visu, simili collo in sectione, (217–)352–401(–452) µm diametro ubi latissima, (92–)95–108(–122) µm diametro apice. Ascosporeae reniformes vel oblongo-ellipticae, uni-septatae, constrictae ubi medianae vel submedianae septatae, (12–)13–15(–22) × (4–)4–5(–7) µm, L:l (2.6–)3.0–3.3(–3.8).

Perithecia immersed in bark, solitary or aggregated, appearing initially as slight elevation of periderm surrounded by a black halo, later developing into a black circular spot, apex protruding through a tiny slit, globose, (277–)320–442(–502) µm high × (382–)475–572(–642) µm diam (mean = 383 × 515, SD 78, 79, n1 = 11, n2 = 10), each with one neck. Neck central to eccentric, relatively short, with punctate ostiolar opening, expanded, initially below epidermis, appearing disk-like when seen from above, like a thick collar in section, becoming exposed, with black halo or circular area below epidermis, when epidermis removed, exposing expanded neck and apex, sometimes two necks joined at expanded area; sometimes black mycelium of developing conidioma above perithecia; neck (152–)257–308(–327) µm long (mean = 263, SD 61, n = 10), (217–)352–401(–452) µm diam at base (mean = 367, SD 67, n = 10), (92–)95–108(–122) µm diam at apex (mean = 103, SD 10, n = 9). Asci cylindrical, (48–)54–62(–77) × (8–)12–14(–18) µm (mean = 58 × 13, SD 7.2, 2.5, n = 15), long stalked, apical ring 2.1–4.3 µm diam, appearing rectangular, with eight ascospores arranged obliquely parallel to multiseriate. Ascospores renoid to oblong-ellipsoid, slightly tapering to rounded ends, slightly curved, one, median to submedian septum, slightly constricted, (12–)13–15(–22) × 4–5(–7) µm (mean = 15 × 5, SD 2.5, 1.0, n = 48), l : w (2.6–)3.0–3.3(–3.8) (mean = 3.2, SD 0.3, n = 48), with granular cytoplasm.

Cultures: Moderate to fast growth on PDA after 7 d a.c.d. 5.2 cm (SD 0.2, n = 8), thin aerial mycelium of velvety to granular texture, whitish to vinaceous buff 86, becoming olivaceous 48 toward margin; fasciculate mycelium buff 45 developing from concave central area; reverse same; 7 d a.c.d. denser mycelium hazel 88 in centre, with vinaceous 86, black droplets on surface, with immersed mycelium dark, reverse dark, with a lighter halo and whitish to translucent margin.

Habitat and host: On dead, still attached twigs of *Salix caprea* and *S. irrorata* (Salicaceae).

Distribution: France (Melle).

Holotype: France, Deux-Sèvres Département, Melle, Melle Arboretum, on *Salix irrorata*, 15 Apr 2008, L.C. Mejía 402, BPI 878959, derived cultures CBS 124976 = LCM 402.02, = LCM402.01.

Additional specimens examined: France, Deux-Sèvres Département, Forêt del' Hermitain, on *Salix caprea*, 17 Apr. 2008, L.C. Mejía 403, BPI 878958, derived cultures LCM403.01, LCM403.02.

Notes: The intricate mycelium that develops above the body of the perithecia in some pustules resembles the conidioma of *Diplodina*, the anamorph of *Plagiostoma*.

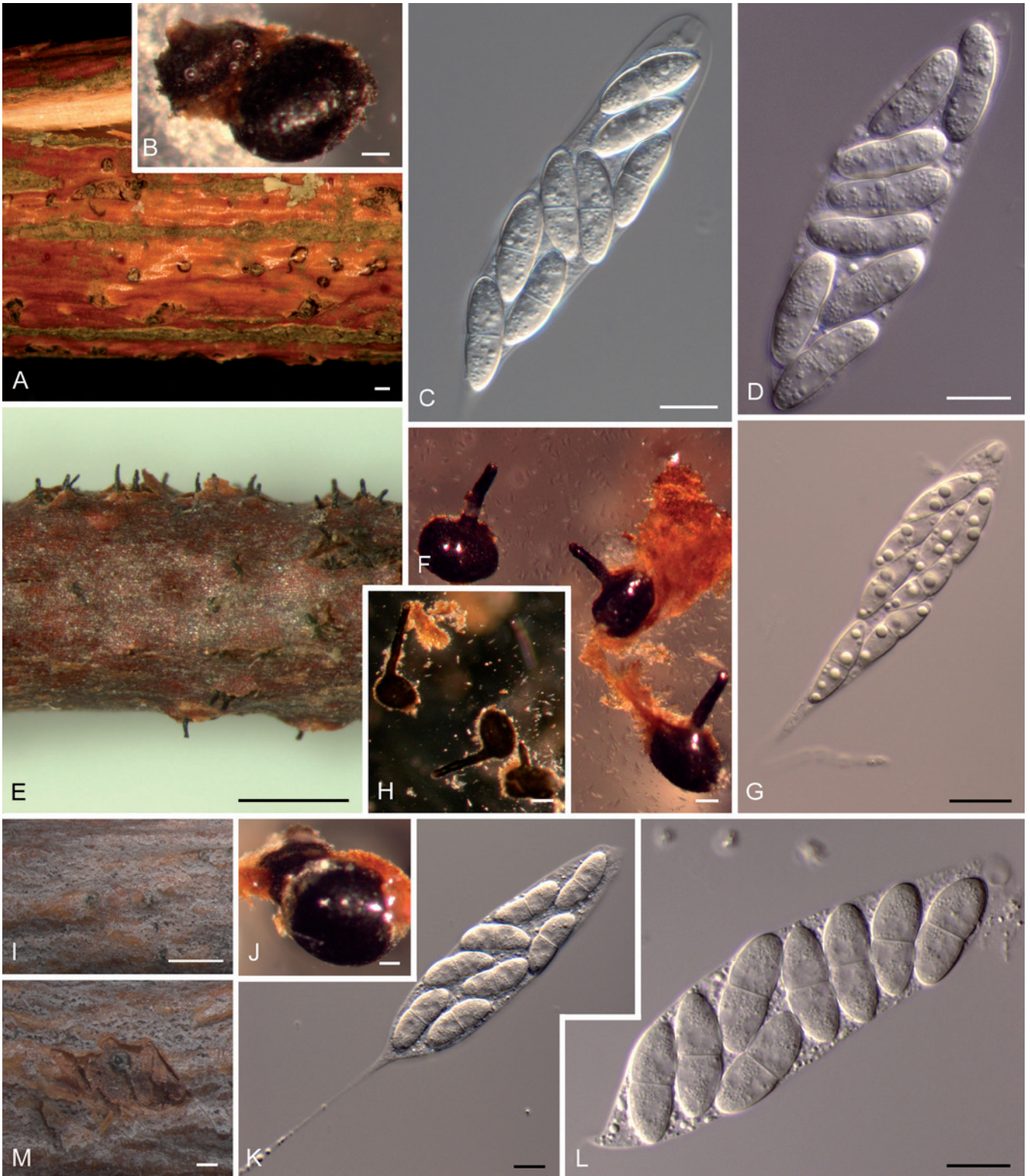


Fig. 3. Morphology on natural substrate. A–D: *Plagiostoma dilatatum*: A–C = BPI 878959 (holotype), D = BPI 878958. E–H: *P. exstocollum*: E–G = BPI 878961 (holotype), H = BPI 878964. I–M: *P. imperceptibile* BPI 878967 (holotype). Bars = (A, E, I) 1mm; (M) 200 μ m; (B, F, H, J) 100 μ m; (C–D) 20 μ m; (G, K–L) 10 μ m.

Plagiostoma euphorbiae (Fuckel) Fuckel, Jahrb. Nassauischen Vereins Naturk. 23–24: 118. 1870.

Basionym: *Sphaeria euphorbiae* Fuckel, Enumeratio Fung. Nassoviae p. 69. 1860.

\equiv *Gnomonia euphorbiae* (Fuckel) Sacc., Michelia 2: 312. 1881.

\equiv *Gnomoniella euphorbiae* (Fuckel) Sacc., Syll. Fung. 1: 418. 1882.

= *Gnomoniella tithymalina* Sacc. & Briard, Rev. Mycol. (Toulouse) 7: 209. 1885 fide Monod (1983).

Note: This species was fully described and illustrated by Fröhlich & Hyde (1995) and Sogonov *et al.* (2008).

Plagiostoma euphorbiaceum (Sacc. & Briard) Sogonov, Stud. Mycol. 62: 72. 2008.

Basionym: *Gnomonia euphorbiacea* Sacc. & Briard, Rev. Mycol. (Toulouse) 7: 208. 1885.

Note: Monod (1983) provided a detailed description of this species. *Plagiostoma euphorbiaceum* is phylogenetically related to *P. amygdalinae* as discussed under that species.

Plagiostoma euphorbiae-verrucosae (M. Monod) Sogonov, Stud. Mycol. 62: 72. 2008

Basionym: *Gnomoniella euphorbiae-verrucosae* M. Monod, Beih. Sydowia 9: 42. 1983.

Note: Monod (1983) provided a detailed description of this species.

Plagiostoma exstocollum L.C. Mejía, *sp. nov.*
MycoBank MB515701. Figs 3E–H, 7M–P.

Etymology: *exsto* – standing out; *collus* – neck, referring to the perithecial neck that emerges from the host periderm.

Perithecia suboblata, (186–)194–227(–278) µm etata, (219–)269–336(–341) µm diámetro, rostrum (197–)247–281(–382) µm longum, (50–)53–63(–67) µm diametro basi, (39–)44–49(–50) µm diametro apice. Ascospores ellipsoideae, uni-septatae, constrictae ubi submedianae septatae, (9–)10–15(–16) × (2–)2–3(–4) µm, L:l (3–)4–4.5(–6).

Perithecia immersed in bark, aggregated in groups up to 12, joined by a scanty, brownish to cream stroma, occasionally solitary, appearing as elevations in bark where perithecial necks emerge through slit or crack in periderm, usually ellipsoid in shape when seen from top, black, suboblata, (186–)194–227(–278) µm high × (219–)269–336(–341) µm diam (mean = 216 × 293, SD 31, 49, n = 9), each with one neck. *Neck* marginal, slightly sulcate, long, (197–)247–281(–382) µm long (mean = 270, SD 54, n = 9), (50–)53–63(–67) µm diam at base (mean = 59, SD 6.1, n = 9), (39–)44–49(–50) µm diam at apex (mean = 46, SD 3.7, n = 9). *Asci* cylindrical to clavate, (15–)39–57(–76) × (3.5–)6.5–11(–13) µm (mean = 49.5 × 8.5, SD 15.1, 2.6, n = 26), apical ring 1.5–3.5 µm diam, with eight ascospores arranged biseriate. *Ascospores* ellipsoid, tapering to rounded ends, 1-septate, constricted at submedian septum, (9–)10–15(–16) × 2–3(–4) µm (mean = 12.5 × 3.0, SD 2.4, 0.7, n = 49), l : w (3–)4–4.5(–6) (mean = 4.3, SD 0.4, n = 49), usually with at least four refractive circular bodies in each ascospore, two large ones on each side of septum, one smaller one at end of each cell.

Cultures: Moderate to fast growth on PDA after 7 d a.c.d. 4.3 cm (SD 1, n = 16), thin aerial mycelium appearing velvety, margin fringed, stringy, whitish to buff 45 or vinaceous buff 86 from top, with a slightly to pronounced halo of thick, white mycelium extending about 2 cm from centre, reverse whitish to buff 45.

Habitat and host: On dead, still attached, overwintered twigs of *Corylus californica* (*Betulaceae*).

Distribution: **USA** (Oregon).

Holotype: **USA**, Oregon, Jackson Co., Upper Rogue River, River Bridge Campground, on *Corylus californica*, 20 May 2008, L.C. Mejía 468, BPI 878961, derived culture CBS 127663 = LCM468.01.

Specimens examined: **USA**, Oregon, Jackson Co., River Bridge Campground, Upper Rogue River, on *Corylus californica*, 20 May 2008, L.C. Mejía 469, BPI 878962; on *Corylus californica*, 21 May 2008, L.C. Mejía 422, BPI 878959, derived culture LCM422.02; on *Corylus californica*, 21 May 2008, L.C. Mejía 472, BPI 878963, derived culture LCM472.01; Upper Rogue River trail, on *Corylus californica*, 21 May 2008, L.C. Mejía 473, BPI 878964, derived culture LCM473.01; Oregon, Lane Co., Willamette National Forest, Salmon Creek, 22 May 2008, L.C. Mejía 483, BPI 878965, derived culture LCM483.01; on *Corylus californica*, 23 May 2008, L.C. Mejía 464, BPI 878960, derived culture LCM464.

Plagiostoma fraxini (Redlin & Stack) Sogonov, Stud. Mycol. 62: 72. 2008.

Basionym: *Gnomoniella fraxini* Redlin & Stack, Mycotaxon 32:185. 1988.

Note: This species, often as its anamorph referred to as *Discula fraxinea* (Peck) Redlin & Stack, causes an anthracnose disease of ash and fringetree (*Oleaceae*) known most commonly in the eastern and midwestern United States, rarely from Oregon (Gregory *et al.* 2004, Rossman *et al.* 2004). Redlin & Stack (1988) provided a detailed description of this species as *Gnomoniella fraxini*.

Plagiostoma geranii (Hollós) Sogonov, Stud. Mycol. 62: 72. 2008.

Basionym: *Gnomonia geranii* Hollós, Annls. Mus. Nat. Hung. 7: 52. 1909.

≡ *Rostrocoronophora geranii* (Hollós) Munk, Dansk Bot. Arkiv 15: 98. 1953.

Note: Müller & Arx (1962) and Monod (1983) provided detailed descriptions of this species as *Gnomonia geranii*.

Plagiostoma imperceptibile L.C. Mejía, *sp. nov.* MycoBank MB515702. Figs 3I–M, 7Q–R.

Etymology: *imperceptibile* referring to the very short, non-protruding neck, thus the species is difficult to see in nature.

Perithecia globosa, (289–)309–356(–414) µm elata, (385–)412–462(–504) µm diametro, rostrum breve, (136–)175–211(–225) µm longum, cum expansa area, disciformi vertice visu, simili collo in sectione, (251–)301–318(–351) µm diametro ubi latissima, (87–)89–100(–113) µm diametro apice. Ascospores reniformes vel oblongo-ellipticae, uniseptatae, constrictae ubi septatae, (18–)19–20(–21) × (5–)6–7(–8) µm, L:l (2.5–)2.9–3.1(–3.8).

Perithecia immersed in bark, solitary, appearing as slight elevations of periderm, central area pale, delimited by black halo from which apex of neck protrudes, black, globose, (289–)309–356(–414) µm high × (385–)412–462(–504) µm diam (mean = 338 × 437, SD 44, 41, n = 7), each with one neck. *Neck* central to eccentric, short, with apex scarcely protruding through a tiny slit, with neck expanded below epidermis, disk-like when seen from above, like a thick collar in section, with black halo or circular black spot through epidermis or black when exposed, (136–)175–211(–225) µm long (mean = 189, SD 38, n = 4), (251–)301–318(–351) µm diam at widest point (mean = 307, SD 36.3, n = 5), (87–)89–100(–113) µm diam at apex (mean = 97.5, SD 10.5, n = 5). *Asci* ovoid elongate, often with long, slender, persistent stalk, (67–)76–80(–87) × (13–)18–21(–24) µm (mean = 77.5 × 19.5, SD 4.9, 3.1, n = 11), apical ring 3.0–4.5 µm diam, with eight ascospores arranged obliquely parallel to multiseriate. *Ascospores* renoid to oblong-ellipsoid, slightly tapering to broadly rounded ends, slightly curved, one median septum, slightly constricted, (18–)19–20(–21) × (5–)6–7(–8) µm (mean = 19.5 × 6.5, SD 0.9, 0.6, n = 45), l : w (2.5–)3(–4) (mean = 3, SD 0.3, n = 45), with granular cytoplasm.

Cultures: Moderate growth on PDA after 7 d a.c.d. 4 cm (SD 0.4, n = 4), thin aerial mycelium of velvety, powdery texture, margin stringy, colour grey becoming vinaceous buff 86 from the top, reverse isabelline 65.

Habitat and host: On twigs of *Salix* sp. (*Salicaceae*).

Distribution: **USA** (California).

Holotype: USA, California, Shasta Co., Cow Creek, close to Old Station, on *Salix* sp., 18 May 2008, L.C. Mejía 456, BPI 878967, derived cultures LCM456.01 and LCM456.02 = CBS 127495.

Note: *Plagiostoma imperceptibile* has an expanded neck similar to other species in the clade, specifically *P. apiculatum*, *P. convexum*, *P. dilatatum*, and *P. pulchellum* (Fig. 1).

Plagiostoma oregonense L.C. Mejía, **sp. nov.** MycoBank MB515703. Figs 4A–C, 7S–T.

Etymology: *oregonense* – from Oregon, referring to the only state in the USA where it was collected.

Perithecia subglobosa, (261–)270–326(–373) µm elata, (369–)381–400(–407) µm diametro; rostrum breve, (156–)168–182(–185) µm longum, cum expansa area, disciformi vertice visu, similis collo in sectione, (176–)182–204(–221) µm diametro ubi latissima, 119–120(–121) µm diametro apice. Ascospores latoellipticae vel ellipticae, uni-septatae, constrictae medianae vel submedianae septatae, (16–)17–19(–22) × (4–)6(–7) µm, L:l (2.6–)2.9–3.2(–4.0).

Perithecia immersed in bark, solitary, evident as conic-shaped elevation of periderm with neck protruding, black, globose to subglobose, (261–)270–326(–373) µm high × (369–)381–400(–407) µm diam (mean = 304 × 389, SD 60, 19, n = 3), each with one neck. Neck eccentric or lateral, expanded, usually attached to periderm, (156–)168–182(–185) µm long (mean = 173, SD 16, n = 3), (176–)182–204(–221) µm diam at base (mean = 195, SD 23, n = 3), (119–)119–120(–121) µm diam at apex (mean = 120, SD 1.0, n = 3). Asci cylindrical, (74–)78–92(–95) × (12–)15–17(–19) µm (mean = 86 × 16, SD 8, 2, n = 10), apical ring 2.8–4.0 µm diam, looks like a stretched hexagon, with eight ascospores arranged obliquely parallel or biserial. Ascospores broadly ellipsoid to ellipsoid, with rounded ends, 1-septate, constricted at median to submedian septum, (16–)17–19(–22) × (4.5–)5.5–6(–7) µm (mean = 18.0 × 6.0, SD 1.5, 0.5, n = 36), l : w (2.6–)2.9–3.2(–4.0) (mean = 3.1, SD 0.3, n = 36), with granular cytoplasm.

Cultures: Moderate growth on PDA after 7 d a.c.d. 4.6 cm (SD 0.1, n = 2), thin aerial mycelium of felty texture, margin fringed, stringy, central area white, with a halo of aerial mycelium 1.5 cm from centre, marginal area buff 45m, reverse with a central circular area of 2 cm diam fawn 87.

Habitat and host: On overwintered branches of *Salix* sp. (*Salicaceae*).

Distribution: USA (Oregon).

Holotype: USA, Oregon, Lincoln Co., Fogarty Creek, on *Salix* sp., 24 May 2008, L.C. Mejía 597, BPI 878968, derived culture LCM597.01 = CBS 126124.

Plagiostoma ovalisporum L.C. Mejía, **sp. nov.** Figs 4D–H, 7U–V.

Etymology: *ovalis* - ovoid; *sporum* - spore, referring to the ovoid shape of the ascospores.

Perithecia globosa, (246–)277–363(–385) µm elata, (394–)403–414(–427) µm diametro; rostrum breve, (131–)146–159(–162) µm longum, apice cupulatum, (125–)136–153(–194) µm basi, (113–)117–160(–168) µm diametro apice. Ascospores ovoideae, non-septatae, (12–)14–16(–17) × (7–)7–8(–9) µm, L:l (1.6–)1.8–2.0(–2.2).

Perithecia immersed in bark, solitary, or in groups up to five, usually in a row, scattered, erumpent, appearing as raised, conical area of bark periderm, with neck protruding through slit or hole, black, globose, (246–)277–363(–385) µm high × (394–)403–414(–427) µm diam (mean = 322 × 409, SD 57, 11, n = 6), each with one neck. Neck lateral, short and thick, apex cupulate, (131–)146–159(–162) µm long (mean = 151, SD 12, n = 6), (125–)136–153(–194) µm diam at base (mean = 150, SD 24, n = 6), (113–)117–160(–168) µm diam at apex (mean = 139, SD 24, n = 6). Asci cylindrical to obclavate, (63.5–)68.5–75.5(–87.5) × (12.5–)14.5–17(–18) µm (mean = 72 × 15.5, SD 6.5, 1.5, n = 19), apical ring 3.5–4.5 µm diam, with eight ascospores arranged obliquely parallel to biserial. Ascospores ovoid, non-septate, appearing double-walled, more evident when stained with cotton blue lactophenol or Melzer's reagent, (12–)14–16(–17) × 7–8(–9) µm (mean = 15 × 7.5, SD 1.2, 0.5, n = 35), l : w (1.6–)1.8–2(–2.2) (mean = 1.9, SD 0.1, n = 35).

Cultures: Moderate growth on PDA after 7 d a.c.d. 4.2 cm (SD 0.1, n = 2), thin aerial mycelium of felty texture, margin fringed, like roots, whitish, with denser mycelium in centre within a radius of 1 cm, reverse buff 45 becoming dark grey, whitish in the margin.

Habitat and host: On dead twigs of *Salix* sp. (*Salicaceae*).

Holotype: USA, Idaho, Idaho Co., near Burgdorf, Burgdorf Rd. FR246, parking area at camping site at Three Mile Creek, approx. GPS: N45° 18.139 W 115° 55.782, elevation 6309 ft, on dead twigs of *Salix* sp., 5 Sep. 2008 (NAMA Annual Foray, Orson K. Miller Jr. Memorial Foray), A.M. Minnis s.n., BPI 878969, derived culture CBS 124977 = LCM458.01.

Notes: This species differs from other species of *Plagiostoma* by having ovoid, non-septate ascospores. The other two known species of *Plagiostoma* with non-septate ascospores, *P. euphorbiae-verrucosae* and *P. fraxini*, occur on hosts other than *Salix* and their ascospores are ellipsoid-fusoid. Unlike *P. dilatatum*, *P. ovalisporum* does not have a circular black halo or spot at the point where the perithecial necks emerge through the periderm.

Plagiostoma petiophilum (Peck) Sogonov, Stud. Mycol. 62: 72. 2008.

Basionym: *Sphaeria petiophila* Peck, Annual Rep. New York State Mus. 35: 144. 1884.

≡ *Gnomonia petiophila* (Peck) Berl. & Voglino, Syll. Fung. Addit. 1–4: 90. 1886.

≡ *Cryptodiaporthe petiophila* (Peck) M.E. Barr, Mycol. Mem. 7: 136. 1978.

Notes: Barr (1978) provided a detailed description of this species as *Cryptodiaporthe petiophila*.

Plagiostoma populinum (Fuckel) L.C. Mejía, **comb. nov.** MycoBank MB515705.

Basionym: *Cryptospora populina* Fuckel, Jahrb. Nassauischen Vereines Naturk. 23/24: 193. 1870.

= *Diaporthe populea* Sacc. in Mouton, Bull. Soc. Roy. Bot. Belgique 26: 174. 1887 fide Butin (1958).

≡ *Cryptodiaporthe populea* (Sacc.) Butin, Sydowia 11: 31. 1958 [1957].

Moderate to fast growth on PDA after 7 d a.c.d. 3.3 cm (SD 1.2, n = 8), thin aerial mycelium of velvety or felty texture, whitish to buff 45 or rosy buff 6 in central area and isabelline 65 in the margin, with some droplets (honey 64) in the centre, with fringed margin appearing like roots, reverse whitish to fawn 87 or honey 64, in



Fig. 4. Morphology on natural substrate. A–C: *Plagiostoma oregonense* BPI 878968 (holotype). D–H. *P. ovalisporum*: BPI 878969 (holotype). I–M. *P. pulchellum*: I, M = BPI 878971, J = BPI 878974, K–L = BPI 878972. Bars = (A, D, I) 1 mm; (K) 300 μ m; (B, E, J) 100 μ m; (H, L–M) 20 μ m; (C, F–G) 10 μ m.

some cultures becoming dark and with a concentric halo light. Cultures are illustrated in Fig. 8A–D.

Notes: Butin (1958) presented a full description with illustrations of this species as *Cryptodiaporthe populea*. Because the name

Cryptodiaporthe populina (Fuckel)Petr. based on *Valsa populina* Fuckel was already occupied in *Cryptodiaporthe*, Butin (1958) based his new combination on *Diaporthe populea* Sacc. When placed in *Plagiostoma* the basionym *Cryptospora populina* Fuckel provides the oldest epithet for this species.

Plagiostoma pulchellum (Sacc. & Briard) L.C. Mejía, **comb. nov.** MycoBank MB515706. Figs 4I–M, 8E–J.

Basionym: *Diaporthe pulchella* Sacc. & Briard in Sacc., Atti Ist. Veneto Sci. 2, Ser. 6, 437. 1884.

≡ *Cryptodiaporthe pulchella* (Sacc. & Briard) Butin, Phytopathol. Z. 32: 407. 1958.

= *Diaporthe recedens* Sacc., Ann. Mycol. 12: 290 1914 *vide* Butin (1958).

Perithecia immersed in bark, solitary, often growing close together, appearing initially as slight elevation of periderm, with black halo or black spot where apex protrudes through a small hole, black, globose, (311–)371–473(–613) µm high × (467–)483–642(–660) µm diam (mean = 435 × 563, SD 128, 99, n = 4), each with one neck. Neck central to eccentric, straight to oblique, with an expanded disk-like area, initially below epidermis, becoming exposed with time, producing black halo or spot at surface, (169–)173–319(–388) µm long (mean = 257, SD 105, n = 4), (153–)209–256(–306) µm diam at widest point (mean = 231, SD 62.5, n = 4), (93–)99–160(–212) µm diam at apex (mean = 137, SD 54, n = 4). Asci ovoid elongated, (75–)85–107(–117) × (15–)17–21(–24) µm (mean = 95 × 19, SD 13.5, 3.0, n = 15), apical ring 4–4.8 µm diam, very thick, with eight ascospores arranged obliquely parallel to multiseriate. Ascospores oblong ellipsoid-elongated, slightly tapering, with rounded ends, straight to slightly curved, one median to submedian septum, not constricted, (17–)18–22(–27) × (5–)6–7(–7.5) µm (mean = 20.3 × 6.3, SD 2.9, 0.6, n = 39), l : w (2.5–)2.9–3.4(–4.4) (mean = 3.2, SD 0.4, n = 39), with granular cytoplasm.

Cultures: Moderate growth on PDA after 7 d a.c.d. 3.9 cm (0.8 n = 6), thin aerial mycelium whitish to rosy vinaceous 58 colour, of velvety, granular texture due to mycelial clumps ca. 500 µm diam, isabelline 65, produced in central area of 2.4 cm diam, central area appearing often moist, margin translucent to buff 45, with hyphae extending radially, stringy, becoming fringed toward margin; reverse whitish to rosy vinaceous 58 or olivaceous. At 14 d small black and dark green slimy droplet surrounded by a second halo rosy vinaceous 58 with white greyish margin, reverse same colour pattern.

Habitat and host: On dead, still attached branches of *Populus balsamifera*, *Populus* sp., *Salix babylonica*, *S. humboldtiana* and *S. lucida* (*Salicaceae*).

Distribution: North America, South America (Argentina), and Europe.

Type specimen: **France**, Troyes, on branch of *Populus alba* cv. *pyramidalis*, Briard n. 5, PAD-not available.

Specimens examined: **Argentina**, Tucumán, vicinity of Villa Nogués, on twigs of *Salix humboldtiana*, 16 Nov 2008, L.C. Mejía 623, BPI 878974, derived cultures LCM623.01 and LCM623.03. **Netherlands**, ex leaf of *Populus balsamifera*, (CBS 170.69 as *Cryptodiaporthe pulchella*). **USA**, Maryland, Prince George's Co., Beltsville, USDA-BARC, outside of B011A, on twigs of *Salix babylonica*, 3 Mar 2008, Amy Y. Rossman & L.C. Mejía 365, BPI 878971, derived culture LCM365.04 = CBS 126653; Maryland, Prince George's Co., Greenbelt, Lake Artemisia, on twigs of *Salix babylonica*, 15 Mar 2008, L.C. Mejía 371, BPI 878972, derived culture LCM371.02; Washington, Kitsap Co., Kitsap Memorial State Park, on twigs of *Salix lucida*, 28 May 2008, L.C. Mejía 438, BPI 878973, derived cultures LCM438.03 (= CBS 126122) and LCM438.04.

Notes: Butin (1958) refers to this species as saprobic on *Populus* spp. The evidence presented in this study shows that this species also infects *Salix* spp. and has a more extensive geographic distribution than previously reported.

Plagiostoma rhododendri (Auersw.) Sogonov, Stud. Mycol. 62: 72. 2008.

Basionym: *Gnomonia rhododendri* Auersw. in Gonn. & Rabenh., Mycol. Europ. 5/6: 26. 1869.

≡ *Apiognomonia rhododendri* (Auersw.) Remler, Bibliotheca Mycologica 68: 74. 1979.

Note: Remler (1979 as *A. rhododendri*) and Monod (1983 as *G. rhododendri*) presented descriptions of this species.

Plagiostoma robergeanum (Desm.) Sogonov, Stud. Mycol. 62: 73. 2008.

Basionym: *Sphaeria robergeana* Desm., Ann. Sci. Nat. Bot. ser. 3, 16: 306. 1851.

≡ *Diaporthe robergeana* (Desm.) Niessl. in Rabenh., Fungi Europ. 2222. 1882.

≡ *Cryptodiaporthe robergeana* (Desm.) Wehm., The Genus *Diaporthe* Nitschke and its Segregates p. 200. 1933.

Note: Wehmeyer (1933) provided a description of this species as *Cryptodiaporthe robergeana*.

Plagiostoma salicellum (Fr.) Sogonov, Stud. Mycol. 62: 73. 2008. Fig. 5A–H.

Basionym: *Sphaeria salicella* Fr., Syst. Mycol. 2: 377. 1823.

≡ *Diaporthe salicella* (Fr.) Sacc., Mycotheca Venet. 135. 1873.

≡ *Gnomonia salicella* (Fr.) J. Schröt., Pilze Schles. 3, 2: 392.1897.

≡ *Chorostate salicella* (Fr.) Traverso, Fl. Ital. Crypt. 2: 203. 1906.

≡ *Cryptodiaporthe salicella* (Fr.) Wehm., The Genus *Diaporthe* Nitschke and its Segregates p. 193. 1933.

Perithecia immersed in bark, solitary or in groups up to five, scattered, evident as slight elevation of periderm, black, subglobose, (157–)208–308(–331) µm high × (339–)372–410(–507) µm diam (mean = 257 × 397, SD 60, 43, n = 11), each with one neck. Neck cylindrical, eccentric to lateral, surrounded by a whitish stroma, (96–)147–202(–308) µm long (mean = 177, SD 67, n = 11), (61–)80–84(–95) µm diam at base (mean = 81, SD 8.8, n = 11), (54–)74–85(–91) µm diam at apex (mean = 79, SD 10, n = 11). Asci cylindrical to clavate, (40–)51.5–59(–63) × (11–)13–14(–15) µm (mean = 55 × 13, SD 5.8, 1.4, n = 15), with apical ring 2.0–3.5 µm diam, with eight ascospores arranged obliquely parallel or irregularly seriate. Ascospores ellipsoid-elongated, slightly tapering toward rounded ends, 1-septate, often with short appendages 1.5–2 µm, slightly constricted at median to submedian septum, (14–)17–20(–27) × 3–4(–5) µm (mean = 18.5 × 3.5, SD 2.3, 0.5, n = 57), l : w (3.2–)5.2–6.6(–8.7) (mean = 5.9, SD 1.1, n = 57), with granular cytoplasm.

Habitat and host: On dead, still attached branches of *Salix alba*, *S. repens*, and *Salix* sp. (*Salicaceae*).

Distribution: Europe.

Lectotype of Sphaeria salicella designated here: Scleromyceti Sueciae 188 issued 1821, Sbarbaro Collection, BPI exsiccati).

Epitype of Sphaeria salicella designated here: **Austria**, St. Margareten im Rosental, Kaernten, Drau-Auen. 9452/1, as *Cryptodiaporthe apiculata* on *Salix alba*, 2 May 2002, W. Jaklitsch 1889, BPI 843527, derived culture CBS 121466.

Additional specimen examined: **Germany**, Langen, on *Salix repens*, L.C. Mejía , BPI 878975, derived culture CBS 126121 = LCM 449.01.

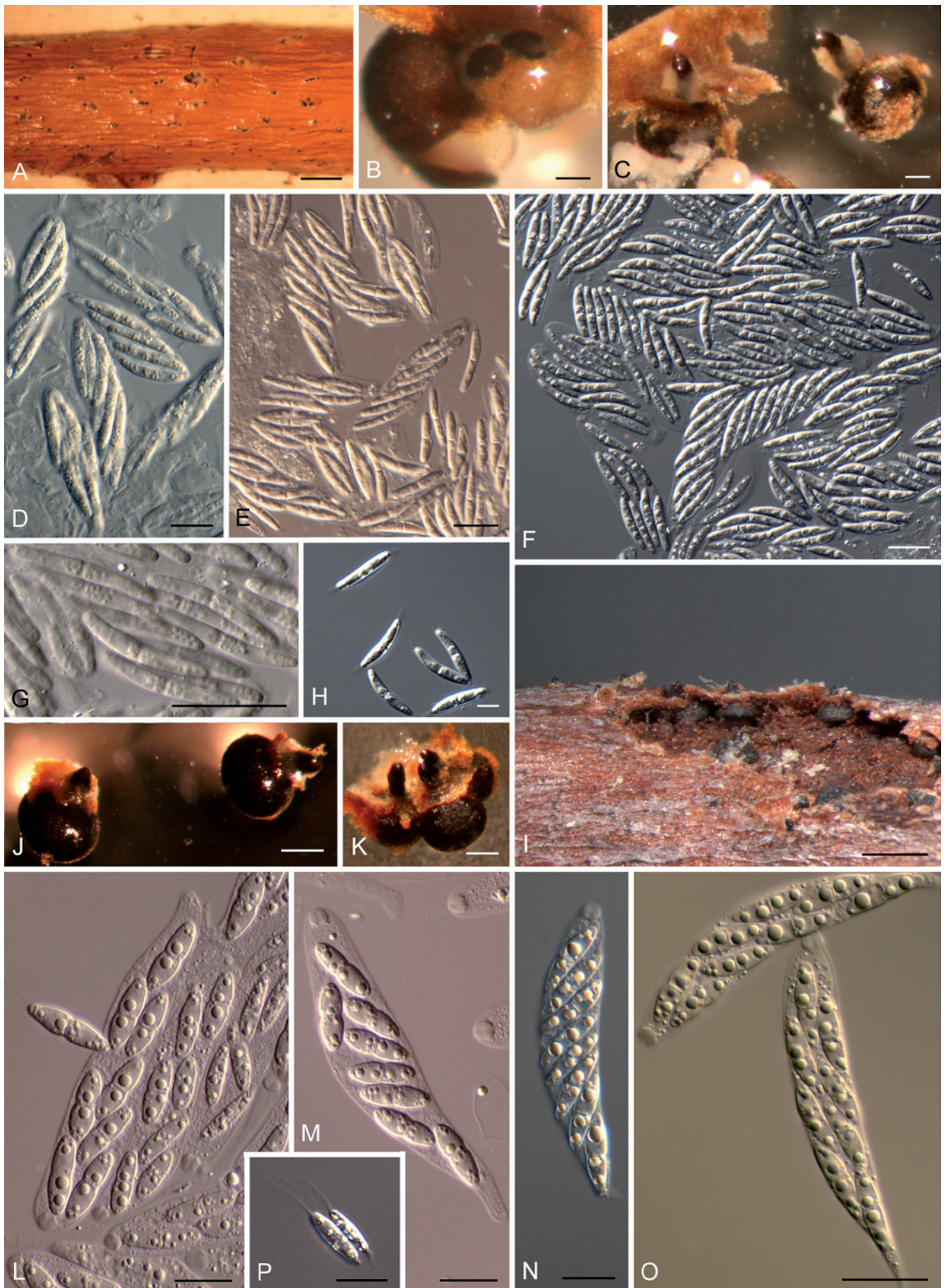


Fig. 5. Morphology on natural substrate. A–H: *Plagiostoma salicellum*: A, B, D, G = Scleromyceci Sueciae 188 (lectotype), C, E, F, H = BPI 843527 (epitype); note whitish stromatic tissue surrounding perithecial neck in Figs 5.5 B and C. I–O: *P. samuelsii*: I, M, P = BPI 878977 (holotype), N–O = BPI 878979. Bars = (A) 1 mm; (I) 500 μ m; (C, J) 200 μ m; (B, K) 100 μ m; (D–G) 20 μ m; (H, L–P) 10 μ m.

Notes: The application of the name *Sphaeria salicella* Fr. has been the source of confusion and the subject of taxonomic studies since the 1800's. It was clearly specified by Fries (1823) that this name is typified by Fries : Scleromyceti Sueciae 188 issued in 1821. According to Wehmeyer (1933) and Butin (1958) confusion about this name was in part due to the fact that different parts of exsiccati Scleromyceti Sueciae 188 contain different species. One of the two species has the narrowly ellipsoid, elongated ascospores of *P. salicellum* while the other has the broadly ellipsoid ascospores of *P. apiculatum*. Not recognising the confusion regarding Scleromyceti Sueciae 188, Petrak (1921) wrongly suggested that *S. salicella* was characterised by having broadly ellipsoid ascospores and made a new combination *Cryptodiaporthe salicella* (Fr.) Petr. in addition to the new combination *C. apiculata* (Wallr.) Petr. based on *S. apiculata* Wallr. The latter species was wrongly considered to have narrowly ellipsoid, elongated ascospores. It is not clear if Petrak (1921) looked at the type specimen of *S. apiculata* or if he based his conclusions solely on the description of *S. apiculata* by Wallroth (1833).

Wehmeyer (1933) arrived at a conclusion different from that of Petrak (1921). Wehmeyer (1933) studied the exsiccati Scleromyceti Sueciae 188 at the Farlow Herbarium and determined that this number and hence *S. salicella* Fr. were characterised by having narrowly ellipsoid, elongated ascospores. To use his words, *S. salicella* represents "the narrow-spored species". He synonymised *S. salicella* Fr. with *C. apiculata* (Wallr.) Petr. and published the combination *C. salicella* (Fr.) Wehm. (1933) non Petrak (1921). In addition, Wehmeyer (1933) made the new combination *C. salicina* (Curr.) Wehm. based on *S. salicina* Curr. for species having broadly ellipsoid ascospores (see notes under *P. convexum*). Later Butin (1958) studied species of *Cryptodiaporthe* on *Populus* and *Salix*, examined Scleromyceti Sueciae 188 at Uppsala Herbarium, and suggested that *S. salicella* should be understood as the species with broadly ellipsoid ascospores and followed Petrak's concept of *S. salicella*.

We studied the Scleromyceti Sueciae 188 (Sbarbaro collection) available at the BPI Herbarium as well as other exsiccati of taxa that have been synonymised with *S. salicella* and *C. salicina* including *S. apiculata*. In doing so we paid close attention to the original descriptions of *S. apiculata* Wallr. and *S. salicella* Fr. In referring to Scleromyceti Sueciae 188 Fries (1823) described *S. salicella* as having a powdery "albicant" (whitish) stroma and that the multiple ostioles are "erumpent simultaneously". The specimen of Scleromyceti Sueciae 188 at BPI includes all of these morphological characters and has ascospores that are ellipsoid elongated (see Fig. 5A, B, D, and G).

In their treatment of *Plagiostoma*, Sogonov *et al.* (2008) made the combination *Plagiostoma salicellum* (Fr.) Sogonov. In our study of *P. salicellum* we noticed that ascospore length and width can be quite variable, even within an ascus, but with a prevalence of elongated ascospores (Fig. 5A–H). A second specimen, BPI 878975 from Germany on *Salix repens*, was sequenced and determined to be conspecific with the epitype of *P. salicellum* within a major clade containing two other species having cylindrical ostioles and ellipsoid elongated ascospores. Unlike the lectotype and epitype of *P. salicellum*, the ascospores of BPI 878975 are ellipsoid but not elongated. In spite of this difference in ascospore morphology, BPI 878975 is *P. salicellum* based on the cylindrical perithecial neck surrounded by a whitish stroma as well as DNA sequence data.

In summary *Plagiostoma salicellum* is characterised by having cylindrical perithecial necks surrounded by a whitish stroma and ascospores predominantly ellipsoid-elongated, less commonly

ellipsoid, tapering to slightly acute, rounded ends (Fig. 5D–G), unlike *P. apiculatum* that has oblong ellipsoid to renoid, broadly rounded ascospores (Fig. 2H–J).

***Plagiostoma samuelsii* L.C. Mejía, sp. nov.** MycoBank MB515707. Figs 5I–O, 8M–P.

Etymology: Named in honour of distinguished mycologist Gary J. Samuels for his outstanding contributions to the systematics of Pyrenomycetes.

Perithecia subglobose, (192–)204–258(–305) µm elata, (295–)302–327(–334) µm diametro, rostrum conicum, (114–)128–161(–170) µm longum, (69–)72–74(–81) µm diametro basi, (58–)62–73(–78) µm diametro apice. Ascosporae ellipticae, uni-septatae, constrictae ubi medianae vel submedianae septatae, (10–)11–12(–19) × 3–4 µm, appendiculatae duabus extremitatibus, anguste filiformes, ascosporis vulgo 2-plo longiores, appendices deliquescentes.

Perithecia immersed in bark, solitary or in groups up to five, scattered on substrate, evident as conical shaped elevations of host periderm with necks protruding through small holes in periderm, black, subglobose, (192–)204–258(–305) µm high × (295–)302–327(–334) µm diam (mean = 239 × 313, SD 43, 16, n = 6), each with one neck. Neck eccentric to lateral, surrounded by a whitish stroma, cone-shaped with rounded apex, (114–)128–161(–170) µm long (mean = 145, SD 23, n = 6), (69–)72–74(–81) µm at base (mean = 73.8, SD 3.9, n = 6), (58–)62–73(–78) µm at apex (mean = 67.5, SD 8.0, n = 6). *Asci* cylindrical to clavate, (32–)42–62(–79) × (6–)7–11(–12) µm (mean = 53 × 9, SD 13, 2.1, n = 24), apical ring 1.8–3.6 µm diam, with eight ascospores arranged obliquely parallel or biserial. *Ascospores* ellipsoid, 1-septate, constricted at median to submedian septum, with two deliquescent appendages, one at end of each cell, narrowly filiform, usually twice the length of ascospores, (10–)11–12(–19) × 3–4 µm (mean = 12 × 3.5, SD 1.4, 0.2, n = 48), l : w (2.8–)3.2–3.5(–4.8) (mean = 3.4, SD 0.4, n = 48), with four refractive bodies in each cell, two big ones near septum, one smaller one at end of each cell.

Cultures: Fast growth on PDA after 7 d reaching edge of petri plates of 6 cm diam (n = 8), thin aerial mycelium of felty to granular texture, fringed, stringy margin, with concentric halo of dense mycelium 1.4 cm from centre, buff 45 inside halo or central region, white toward margin, some cultures with depression at concentric halo, reverse honey 64 developing a halo fawn 87 near margin.

Habitat and host: On dead, still attached twigs and branches of *Alnus incana* var. *tenuifolia*, *A. rubra*, and *Alnus* spp. (*Betulaceae*).

Distribution: USA (California, Oregon, Washington).

Holotype: USA, California, Plumas Co., Little Last Chance Creek, Chilcook Campground, on *Alnus incana* var. *tenuifolia*, 17 May 2008, L.C. Mejía 454, BPI 878977, derived CBS 125668 = LCM454.04.

Specimens examined: USA, Oregon, Jackson Co., Upper Rogue River, on *Alnus* (*tenuifolia*?), 21 May 2008, L.C. Mejía 419, BPI 878976, derived culture LCM419.01 and LCM419.02; Upper Rogue River trail on *Alnus* sp. 21 May 2008, L.C. Mejía 474, BPI 878978, derived culture LCM474.01; Washington, Clallam Co., Crescent Lake, on *Alnus rubra* (branch on soil), 27 May 2008, L.C. Mejía 596, BPI 878979, derived culture LCM596.01.

Notes: *Plagiostoma samuelsii* is the only species of *Plagiostoma* on leaves of *Alnus* except for *P. jensenii* M.E. Barr. Unlike *P. samuelsii*,

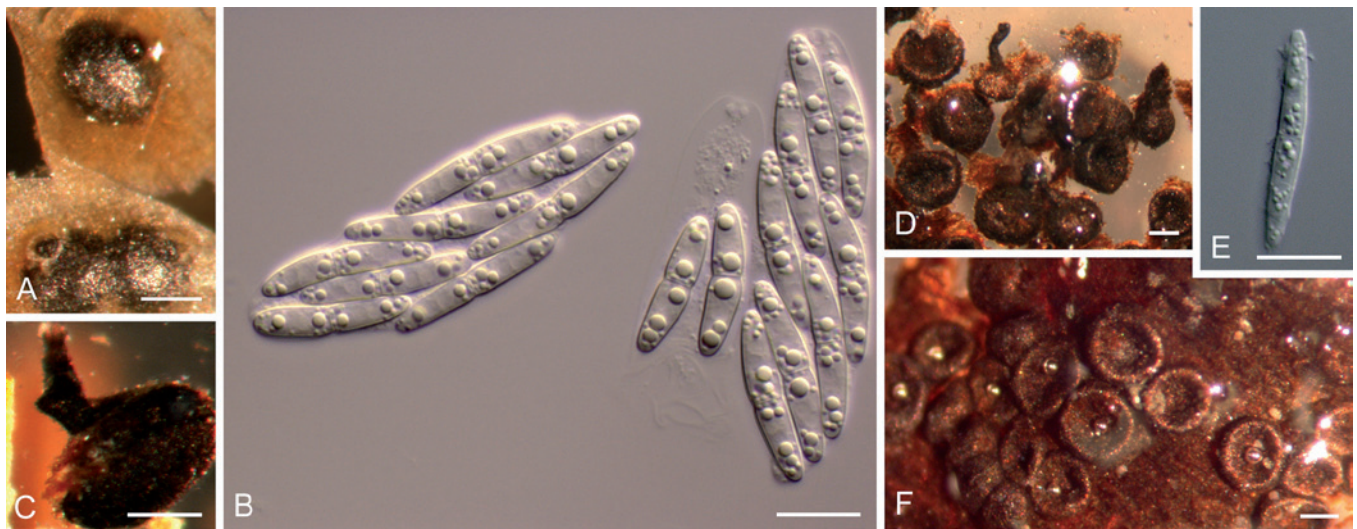


Fig. 6. Morphology on natural substrate. A–C. *Plagiostoma versatile*: A–B = BPI 878980 (holotype), C = BPI 877702. D–F. *P. yunnanense* BPI 878983 (holotype). Bars = (A, C–D, F) 200 µm; (B, E) 10 µm.

P. jensenii lacks a stroma and perithecial neck and has longer and wider ascospores (20–30 × 4–6 µm) with very short pulvinate appendages (Barr 1991). Most likely *P. jensenii* does not belong in *Plagiostoma*.

Plagiostoma versatile L.C. Mejía & Sogonov, **sp. nov.** MycoBank MB515708. Figs 6A–C, 8Q–V.

Etymology: *versatile* – versatile, referring to the occurrence of this species on different plant organs, twigs, branches, and leaves; and to the variable nature of the perithecia that grow with short necks on twigs and branches and with medium to long necks on leaves.

Perithecia subglobosa, (178–)194–317(–345) µm elata, (232–)264–378(–444) µm diametro; rostrum cylindricum, (60–)77–137(–226) µm longum, (51–)56–80(–87) µm diametro basi, (37–)49–60(–76) µm apice. Ascospores elliptico-elongatae, uni-septatae, constrictae ubi medianae vel submedianae septatae, (18–)20–23(–25) × 3–4 µm, L:l (4.9–)5.6–6.8(–8.6).

Perithecia immersed in bark of twigs or in midvein and petioles of adaxial and abaxial side of leaves, solitary or in pairs, scattered, on twigs evident as slight elevations of periderm that appear black, upper part of perithecia showing a few cell layers below epidermis, on leaves producing swollen, raised areas on midvein, becoming highly erumpent, cracking periderm and leaving an ellipsoidal cavity, with longer neck on leaves than on twigs, black, subglobose, (178–)194–317(–345) µm high × (232–)264–378(–444) µm diam (mean = 248 × 323, SD 68.5, 78, n = 8), each with one neck. **Neck** eccentric to lateral, short, ostiolar opening sulcate with four grooves, (60–)77–137(–226) µm long (mean = 115, SD 59.7, n = 8), (51–)56–80(–87) µm diam at base (mean = 68.5, SD 13.4, n = 8), (37–)49–60(–76) µm diam at apex (mean = 55, SD 11.8, n = 8). **Asci** cylindric to clavate, (49–)54–66(–71) × (11–)13–16(–20) µm (mean = 60 × 15, SD 7.5, 2.5, n = 15), apical ring 2.0–3.5 µm diam, with eight ascospores arranged biserially. **Ascospores** ellipsoid elongated, slightly tapering toward rounded ends, 1-septate, constricted at median to submedian septum, (18–)20–23(–25) × 3–4 µm (mean = 21.5 × 3.5, SD 2.0, 0.4, n = 36), l : w (4.9–)5.6–6.8(–8.6) (mean = 6.2, SD 1.0, n = 36), usually with four large refractive bodies, two near septum, one in each end of cells.

Cultures: Fast growth on PDA after 7 d reaching the edge of petri plates of 6 cm diam (n = 12), thin aerial mycelium of felty to granular

texture, margin fringed, like roots, buff 45 with clumps of white mycelium, with a halo of elevated mycelium at 1.5 cm from centre, reverse buff 45 becoming dark, with halo visible from reverse.

Habitat and hosts: On dead twigs of *Salix scouleriana* and *Salix* sp., on overwintered leaves of *Salix* sp. (*Salicaceae*).

Distribution: **USA** (Oregon, Washington); **Canada** (British Columbia).

Holotype: **USA**, Washington, Jefferson Co., intersection of Upper Hoh River Road & Route 101, on *Salix scouleriana*, 27 May 2008, L.C. Mejía 594, BPI 878980, derived culture CBS 124978 = LCM594.01.

Additional specimens examined: **Canada**, British Columbia, Vancouver, on overwintered dead leaves of *Salix* sp., 12 May 2006, M. V. Sogonov 379, BPI 877702, derived culture CBS 121251 = AR4294. **USA**, Oregon, Lane Co., Willamette Pass, on *Salix* sp., 22 May 2008, L.C. Mejía 598, BPI 878982, derived culture LCM598.01; Washington, Jefferson Co., Hoh River Campground, on *Salix scouleriana*, 27 May 2008, L.C. Mejía 595, BPI 878981, derived culture LCM595.01.

Notes: The ascospores of this species are similar to those of *Plagiostoma salicellum*, however, the perithecial necks of *P. versatile* lack the whitish stroma characteristic of *P. salicellum*.

Plagiostoma yunnanense L.C. Mejía & Zhu L. Yang, **sp. nov.** MycoBank MB515709. Figs 6D–F, 8W–X.

Etymology: referring to the place where this species was collected: Yunnan, China.

Perithecia globosa, (231–)267–311(–318) µm elata, (282–)312–352(–362) µm diametro, rostrum cylindricum, contortum, (315–)318–321(–322) µm longum, (77–)78–81(–82) µm diametro basi, (57–)59–63(–66) µm diametro apice. Ascospores elliptico-elongatae, uni-septatae, leviter vel non constrictum ubi septatae, (19–)23–26(–27) × 3–4, L:l (6.6–)6.8–7.9(–8.2).

Perithecia immersed, solitary or in groups, numerous, appearing as conical elevations of periderm where necks protrude, black, globose, (231–)267–311(–318) µm high × (282–)312–352(–362) µm diam (mean = 284 × 328, SD 48, 42, n = 3), each with one neck. **Neck** eccentric, contorted, (315–)318–321(–322) µm long (mean = 319, SD 3.8, n = 3), (77–)78–81(–82) µm diam at base (mean = 79,

SD 2.4, n = 3), (57–)59–63(–66) µm diam at apex (mean = 61, SD 4.8, n = 3). *Asci* not observed. *Ascospores* ellipsoid-elongate, with rounded ends, 1-septate, slightly or not constricted at median to submedian septum, (19–)23–26(–27) × 3–4 µm (mean = 24 × 3.3, SD 2.7, 0.4, n = 6), l : w (6.6–)6.8–7.9(–8.2) (mean = 7.3, SD 0.7, n = 6), with granular cytoplasm.

Cultures: Moderate growth on PDA after 7 d a.c.d. 3.4 cm (SD 0.2, n = 4). Mycelium of granular texture, margin stringy, whitish with granules, becoming grey or vinaceous buff, reverse with dark inclusions near centre, most of colony whitish.

Habitat and host: On dead, still attached branches of *Salix* sp. (*Salicaceae*).

Distribution: China (Yunnan).

Holotype: **China**, Yunnan, Ailoshan, on *Salix* sp., 14 Jul. 2008, L.C. Mejía 513, BPI 878983, derived cultures CBS 124979 = LCM513.03 and LCM513.02.

Additional names in *Cryptodiaporthe* and *Plagiostoma*

Cryptodiaporthe acerinum J. Reid & Cain, *Canad. J. Bot.* 40: 839. 1962.

Notes: A fresh specimen determined to be this species was cultured and sequenced. Analyses of LSU and RPB2 sequences place this species in a basal branch of the *Gnomoniaceae*.

Specimen examined: **USA**, New York, Adirondacks, Cranberry Lake, on dead branch of *Acer* sp., 13 Jun. 2002, L. Vasilyeva, BPI 870989, culture CBS 121465 = AR 3822.

Cryptodiaporthe aculeans (Schwein.) Wehm., *The Genus Diaporthe* Nitschke and its Segregates p. 212. 1933.

Basionym: *Sphaeria aculeans* Schwein., *Trans. Am. Phil. Soc., New Series* 4(2): 204. 1834. [1832].

Notes: The only available culture of this species was sequenced. Analyses of LSU sequences place this species in a clade sister to the *Melanconidaceae*.

Culture sequenced: **Japan**, on branch of *Rhus javanica*, isol. G. Okada, CBS 525.85.

Cryptodiaporthe aubertii (Westend.) Wehm., *The Genus Diaporthe* Nitschke and its Segregates 202. 1933.

Basionym: *Sphaeria aubertii* Westend., *Bull. Acad. R. Sci. Belg., Cl. Sci., sér. 2: tab. 7, no. 5.* 1859.

Notes: A culture of this species was sequenced. Analyses of this LSU sequence suggests that this species is related to the genus *Cryptosporella* within the *Gnomoniaceae*.

Culture sequenced: **Sweden**, Småland, on *Myrica gale*, 14 Apr. 1989, K. & L. Holm, isol. O. Constantinescu 89–53, CBS 114196.

Cryptodiaporthe galericulata (Tul. & C. Tul.) Wehm., *The Genus Diaporthe* Nitschke and its Segregates p. 211. 1933.

Basionym: *Valsa galericulata* Tul. & C. Tul., *Select. Fung. Carpol.* (Paris) 2: 203. 1863.

Notes: A fresh specimen determined to be this species was cultured and sequenced. Analyses of LSU sequences suggest this species belongs in the *Sydowiellaceae*.

Specimen examined: **USA**, Tennessee, Great Smoky Mts. National Park, near Cosby, Horse Trail, on *Fagus grandifolia*, 25 Mar. 2002, L. Vasilyeva, BPI 863767 ex culture AR 3811.

Cryptodiaporthe liquidambaris Petr., *Sydowia* 5: 236. 1951.

Notes: A fresh specimen determined to be this species was cultured and sequenced. Analyses of LSU sequences place this species within the *Diaporthales* but not within any described family.

Specimen examined: **USA**, Maryland, Beltsville, on overwintered twig of *Liquidambar styraciflua*, 15 May 2001, M. Barr, isol. A. Rossman, BPI 749123 culture AR 3648 (now dead).

Cryptodiaporthe macounii (Dearn.) Wehm., *The Genus Diaporthe* Nitschke and its Segregates p. 191. 1933.

Basionym: *Diaporthe macounii* Dearn., *Mycologia* 8: 100. 1916.

Note: This species was included in the genus *Gnomoniopsis* (*Gnomoniaceae*) by Sogonov *et al.* (2008).

Cryptodiaporthe vepris (Delacr.) Petr., *Ann. Mycol.* 32: 445. 1934.

Basionym: *Sphaeria vepris* Delacr., *Fungi europ.* 443. 1862.

Notes: A fresh specimen determined to be this species was cultured and sequenced. Analyses of LSU sequences place this species within the *Diaporthales* but not in any described family.

Specimen examined: **Austria**, Wograda, St. Margareten, Kaernten, on *Rubus idaeus*, 27 Oct. 2000, W. Jaklitsch 1661, isol. A. Rossman, BPI 749132, culture AR 3559.

Plagiostoma acerophilum (Dearn. & House) M.E. Barr, *Mycol. Mem.* 7: 113. 1978.

Basionym: *Gnomoniopsis acerophila* Dearn. & House, *Bull. New York State Mus.* 233–234: 36. 1921.

Notes: A fresh specimen determined to be this species was cultured and sequenced. This species falls within the *Gnomoniaceae* according to analyses of ITS sequences but not within any known genus. The perithecial neck of this species is lateral, upright, and slightly curved at the apex.

Specimens examined: **USA**, New York, Sullivan Co., Roscoe, on overwintered leaves of *Acer pensylvanicum*, Jul. 2005, M.V. Sogonov MS 0302, BPI 877681; Tennessee, Blount Co., Great Smoky Mountains National Park, Cades Cove, on overwintered petioles of *Acer pensylvanicum*, 24 May 2006, M.V. Sogonov MS 0467, BPI 877679; Sevier Co., Great Smoky Mountains National Park, on overwintered leaves and petioles of *Acer pensylvanicum*, 22 May 2006, M.V. Sogonov MS 0473, BPI 877682.

Plagiostoma alneum (Fr.) Arx, *Antonie van Leeuwenhoek* 17: 264. 1951.

= *Sphaeria alnea* Fr. : Fr., *Observ. mycol.* 1: 185. 1815 : *Syst. Mycol.* 2: 520. 1823.

Notes: This species is now regarded as *Gnomonia alnea* (Fr.) Sogonov and was described and illustrated in Sogonov *et al.* (2008).

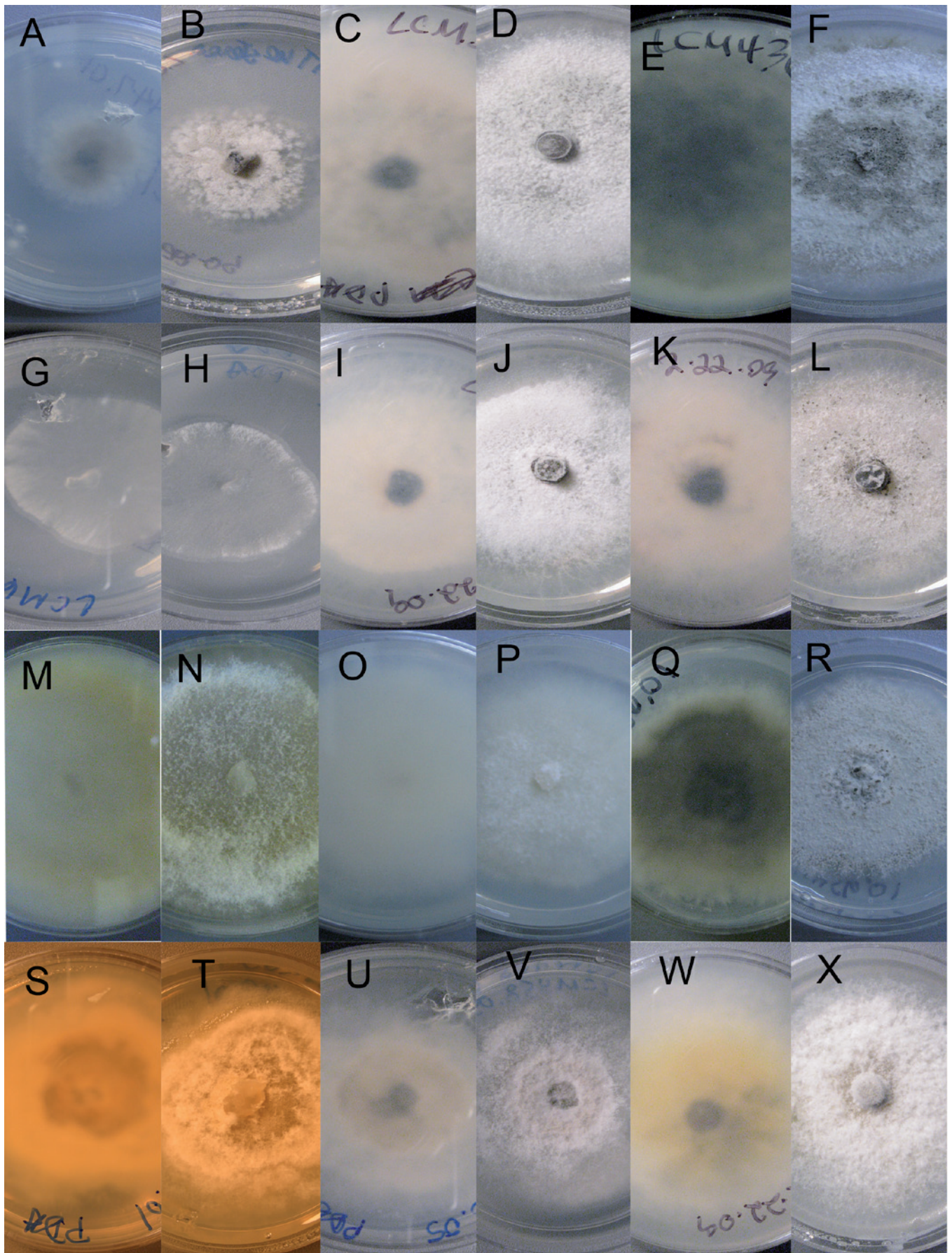


Fig. 7. Culture morphology. A–B. *Plagiostoma aesculi*. CBS 126127 = LCM447.01. C–F. *P. apiculatum*. C–D. LCM 393.01. E–F. CBS 126126 = LCM436.01. G–H. *P. barriae*. LCM 601.02. I–L. *P. dilatatum*. I–J. LCM 402.01. K–L. LCM 403.01. M–P. *P. exstocollum*. M–N. LCM 422.02. O–P. LCM 468.02. Q–R. *P. imperceptibile*. LCM 456.01. S–T. *P. oregonense*. Ex-type CBS 126124 = LCM 597.01. U–V. *P. ovalisporum*. LCM 458.05. W–X. *P. petiophilum*. CBS 126123 = LCM 181.01. A–D, I–L, W–X. Colony habit, 10 d, 23 °C. E–H, M–R, U–V. Colony habit, 9 d, 23 °C. S–T. Colony habit, 7 d, 23 °C. A, C, E, G, I, K, M, O, Q, S, U, W. Reverse. B, D, F, H, J, L, N, P, R, T, V, X. Surface.

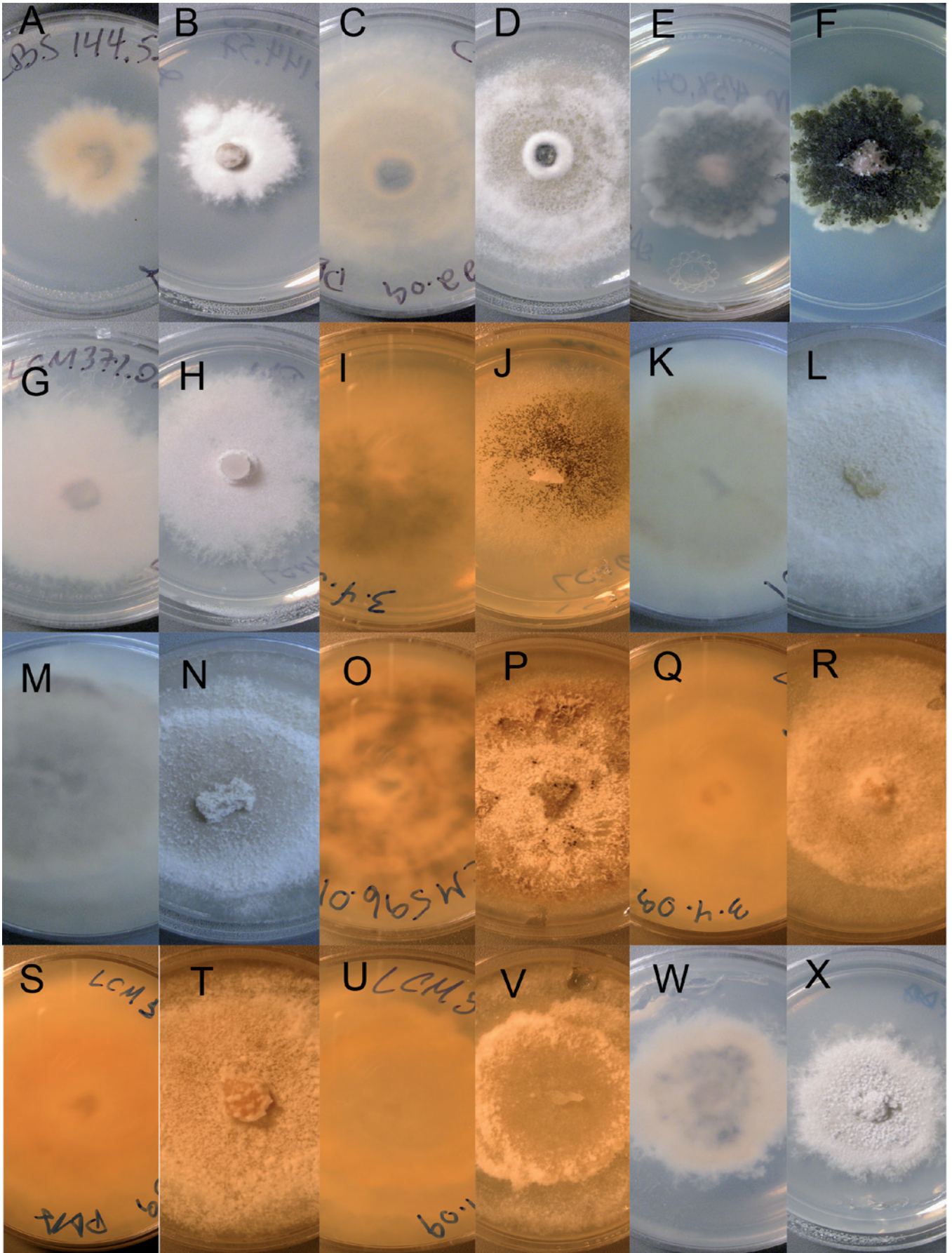


Fig. 8. Culture morphology. A–D. *Plagiostoma populinum*. A–B. CBS 144.57. C–D. CBS 174.58. E–J. *P. pulchellum*. E–F. LCM 438.04. G–H. LCM 371.02. I–J. LCM 623.01. K–L. *P. salicellum*. CBS 126121 = LCM449.01. M–P. *P. samuelsii*. M–N. Ex-type CBS 125668 = LCM 454.04. O–P. LCM 596.01. Q–V. *P. versatile*. Q–R. Ex-type CBS 124978 = LCM 594.01. S–T. LCM 595.01. U–V. LCM 598.01. W–X. *P. yunnanense*. Ex-type CBS 124979 = LCM 513.03. A–D, G–H, W–X. Colony habit, 10 d, 23 °C. E–F, K–N. Colony habit, 9 d, 23 °C. I–J, O–V. Colony habit, 7 d, 23 °C. A, C, E, G, I, K, M, O, Q, S, U, W. Reverse. B, D, F, H, J, L, N, P, R, T, V, X. Surface.

Plagiostoma arnstadiense (Auersw.) M. Monod, Beihefte Sydowia 9: 143. 1983.

Basionym: *Gnomonia arnstadiensis* Auersw. in Gonnerm. & Robenh., Mycol. Europ. 5/6: 22. 1869.

Notes: This species is now accepted in *Gnomonia* according to Sogonov *et al.* (2008).

Plagiostoma bavaricum (Rehm) M.E. Barr, Mycol. Mem. 7: 112. 1978.

Basionym: *Hypospila bavarica* Rehm, Ann. Mycol. 6:322. 1908.

Note: Based on an LSU sequence, this species belongs in the *Gnomoniaceae* but it cannot be placed in a genus.

Culture sequenced: **Switzerland**, on *Acer opalus*, M. Monod, CBS 772.79.

Plagiostoma conradii (Ellis) M.E. Barr, Mycol. Mem. 7: 107. 1978.

Basionym: *Diaporthe conradii* Ellis, Am. Nat. 17: 316. 1883.

Notes: A fresh specimen determined to be this species was cultured and sequenced. Analysis of the LSU sequence suggests this species is closely related to *Cryptodiaporthe aubertii* and *Cryptosporella* but not within any known genus in the *Gnomoniaceae*. The perithecial neck of this species is lateral and upright.

Specimen examined: **USA**, New Jersey, on living stems of *Hudsonia tomentosa*, G. Bills, BPI 746482, culture CBS 109761 = AR 3488.

Plagiostoma inclinatum (Auersw.) M.E. Barr, Mycol. Mem. 7: 115. 1978.

Basionym: *Gnomonia inclinata* Auersw. in Rabenh., Mycol. Europ. 5/6: 27. 1869.

[= *Sphaeria inclinata* Desm., Ann. Sci. Nat. Bot. III, 16: 315. 1851 non Schwein. 1832]

Notes: Two isolates of this species were sequenced. This species apparently belongs in the *Gnomoniaceae* but it cannot be placed in a genus.

Cultures sequenced: **The Netherlands**, on dead leaf of *Acer pseudoplatanus*, CBS 209.67. **Switzerland**, on *Acer platanoides*, M. Monod, CBS 830.79.

Plagiostoma jensenii M.E. Barr, Mycotaxon 41: 298. 1991.

Note: Based on the lack of a perithecial neck and the pulvinate appendages on the ascospores, *P. jensenii* most likely does not belong in *Plagiostoma*.

Plagiostoma lugubre (P. Karst.) Bolay, Ber. Schweiz. Bot. Ges. 81: 436. 1972.

Basionym: *Gnomonia lugubris* P. Karst., Bidr. Känn. Finl. Nat. Folk 23: 121. 1873.

Note: The disposition of this species was not investigated in this study.

Plagiostoma magnoliae (Ellis) M.E. Barr, Mycol. Mem. 7: 117. 1978.

Basionym: *Gnomonia magnoliae* Ellis, Amer. Nat. 17: 318. 1883.

Notes: This species has been reported in leaves of *Magnolia virginiana* in North America. The perithecial neck of this species is lateral and obliquely upright as drawn by Barr (1978). The disposition of this species was not investigated in this study.

Plagiostoma micromegalum (Ellis & Everh.) M.E. Barr, Mycol. Mem. 7: 112. 1978.

Basionym: *Diaporthe micromegala* Ellis & Everh., Proc. Acad. Nat. Sci. Philadelphia 1893: 449. 1894.

Notes: This species is now placed in *Ophiognomonia* as *O. micromegala* (Ellis & Everh.) Sogonov according to Sogonov *et al.* (2008).

Plagiostoma petrakii (E. Müll.) M. Monod, Beihefte Sydowia 9: 146. 1983.

Basionym: *Plagiostigme petrakii* E. Müll., Sydowia 18:90. 1965.

Note: No material of this species was located.

Plagiostoma pseudobavaricum M. Monod, Beihefte Sydowia 9: 151. 1983.

Notes: ITS sequences of this species were included in a phylogenetic analysis. Although closely related to *Apiognomonia* and *Plagiostoma*, the results suggest that this species may represent an undescribed genus within the *Gnomoniaceae*.

Specimens examined: **USA**, New York, Adirondack Mts., Cranberry Lake, on petioles of *Acer* sp., 22 Jun. 2002, L. Vasilyeva, BPI 843494, ex culture AR 3819; *ibid.*, 23 Jun. 2002, L. Vasilyeva, BPI 843495, ex culture AR 3894; Tennessee, Sevier Co., Great Smokey Mountains National Park, on overwintered petioles of *Acer saccharum*, 22 May 2006, M.V. Sogonov MS 0483, BPI 877700.

Plagiostoma robertiani (Petr.) M.E. Barr, Mycol. Mem. 7: 113. 1978.

Basionym: *Gnomonia robertiani* Petr., Ann. Mycol. 23: 122. 1925.

Note: No material of this species was located.

Plagiostoma tormentillae (Lind) Bolay, Ber. Schweiz. Bot. Ges. 81: 436. 1971.

Basionym: *Gnomoniella tormentillae* Lind, Bot. Tidsskr. 41: 217. 1931.

Note: This species is now recognised as *Gnomoniopsis tormentillae* (Lind) Sogonov according to Sogonov *et al.* (2008).

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