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Studies in *Hyaloscyphaceae* associated with major vegetation types in the Canary Islands II: a revision of *Hyaloscypha*

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Abstract: Four species of the genus *Hyaloscypha* are presented for the Canary Islands. The study is based on recent collections and 12 previous records. The earlier reports of the genus (*Hyaloscypha fuckelii*, *H. hyalina* and *H. leuconica*) are corrected. All of the reported species are new to the Canarian archipelago (*H. aureliella*, *H. intacta*, *H. spiralis* and *H. strobicola*), and only one has been reported before from the Macaronesian region (*H. aureliella*). A key, descriptions, illustrations and notes about ecology are provided.

Key words: *Ascomycota*, Canary Islands, diversity, *Helotiales*, *Hyaloscyphaceae*, *Hyaloscypha*, Macaronesia, new records, taxonomy

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Introduction

The genus *Hyaloscypha* Boud. contains c. 38 species worldwide (Kirk & al. 2008). This generic name appeared for the first time in a floristic work of Gillet (1879), but it was really established six years later by Boudier (1885), who characterized the genus by its fleshy and broadly sessile apothecia with few hairs; cylindric-clavate, branched and septate paraphyses not protruding above the asci; and aseptate ascospores with drops. Boudier (1885) gave two species as examples, i.e. *Helotium vitreolum* (P. Karst.) P. Karst. and *Peziza dentata* Pers., and later (Boudier 1907) included 34 species, but it was Velenovský (1934, 1939, 1947) who totally blurred the generic limits of the genus, including 70 taxa (Svrček 1985). Also Dennis (1949, 1956) had apparent problems in delimiting the genus. Huhtinen (1989) included 20 species in his monograph of *Hyaloscypha*, five of them with two varieties each and one with three varieties. Also, a historical overview of the taxonomic problems in the genus after Boudier was given by Huhtinen (1989). *Hyaloscypha vitreola* (P. Karst.) Boud. had earlier been proposed as the conserved type of the generic name (Huhtinen & Cannon 1987) and was later accepted.

Nowadays, the teleomorph of *Hyaloscypha* is characterized by its minute, sessile to subsessile apothecia, with hyaline, lageniform to conic hairs, ectal excipulum with a *textura prismatica* and filiform paraphyses; while its anamorphs are *Hyphomycetes* (*Cheiromycella*, *Pseudaegerita* and *Phialophora*-type), which have holoblastic or enteroblastic conidiogeny (Huhtinen 1989). Recently, the monophyly of the genus was shown, and two varieties [*H. albohyalina* var. *spiralis* (Velen.) Huhtinen and *H. albohyalina* var. *monodictys* Hosoya & Huhtinen] were raised to species level (Han & al. 2014). The species of *Hyaloscypha* are saprobes mainly of wood, but they appear also on arboreal and herbaceous litter. Quite recently, notable extentions to this basic ecology have

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been introduced: Baral & al. (2009) emended the genus to include two hepaticolous species, and Stenroos & al. (2010) briefly discussed two unnamed *Hyaloscypha* species that are bryophilous.

Although some authors have pointed out the possibility of substrate specificity (Velenovský 1934; Dennis 1949), nowadays it has been observed that the host seldom influences species differentiation. Huhtinen (1989) recognized six major ecological groups: (1) growing on softwoods (wood of gymnosperm trees such as conifers), (2) growing on hardwoods (wood of angiosperm trees, deciduous or evergreen), (3) growing on both softwoods and hardwoods, (4) restricted to oak wood, (5) inhabiting all types of litter, and (6) confined to herbaceous litter. The genus is considered widespread, mainly distributed in the temperate N hemisphere; there are also some reports from the S hemisphere in Australia, Argentina, Chile, New Zealand, Philippines, South Georgia, and Tristan da Cunha (GBIF; Huhtinen 1989). The phenology of the different species of *Hyaloscypha* was presented in Huhtinen (1989). He observed that fruiting appears during the whole frost-free season and tends to diminish from September onward.

Three species of the genus have been reported in the Canary Islands: *Hyaloscypha fuckelii* Nannf., *H. hyalina* (Pers.) Boud. and *H. leuconica* (Cooke) Nannf. in Beltrán-Tejera & al. (2004, 2008) and Ribes (2009). The aim of this investigation is to contribute to the knowledge of the genus *Hyaloscypha* in the Canary Islands, providing revision of previously collected specimens, detailed descriptions, keys and ecological data.

Material and methods

Methods for collection, types of vegetation explored, and macro- and microscopic techniques for examination of apothecia follow Del Arco & al. (2010) and Quijada & al. (2015). All previously reported specimens were revised to confirm or correct their identity. Specimens are deposited at the mycological section of the herbarium of the University of La Laguna (TFC; herbarium code follows Thiers 2016+). Colour coding refers to ISCC-NBS (Anonymous 1976). Municipalities and names for localities follow IDE-Canarias visor 3.0 (http://visor.grafcan.es/visorweb/). The {number of studied specimens} is indicated in curly brackets, except if only one collection was found.

Abbreviations and symbols used: CRB = aqueous cresyl blue, CR = aqueous congo red, f.g. = frequency of guttule content between 0–90 % according to Baral & Marson (2005), idem = the same, KOH = potassium hydroxide, LUG = Lugol's solution, MLZ = Melzer's reagent, *n* = number of measures, pop. = populations studied, *t.* = *textura*, * = living state, † = dead state.

Main collectors cited: *EBT* = Esperanza Beltrán-Tejera, *CQ* = Camilo Quijada, *LQ* = Luis Quijada, *RN* = Rubén Negrín.

Results

Hyaloscypha aureliella (Nyl). Huhtinen in Karstenia 29(2): 107. 1989. – Fig. 1.

Description — Fresh apothecia 0.2–0.5 mm in diam., to 0.2 mm high, subgregarious to strongly gregarious, not erumpent, subsessile, pink-white (9.pkWhite) to light orange-yellow (70.l.OY) when dry, margin hairy. Hairs hyaline, conic, tapering to a wide blunt apex, seldom solidified, 0- or 1(or 2)-septate, generally straight to rarely slightly sinuous; surface smooth or with dispersed warts, agglutinated by golden-yellow resinous exudate that dissolves totally in MLZ but is ± intact in CR, KOH or LUG; at upper flank *(14–)24.5–37.5(–44) µm {12} long, *(1.7–)2.5–3.5 µm {12} wide at base, at margin *(20–)26–30.5(–35.5) µm {12} long, *(2.5–)3–3.5(–4) µm {12} wide at base; apex tapering to *1–1.5(–2) µm {12} wide. Asci *(34.5–)39–43(–49) × (5–)6–6.5(–7) µm (*n* = 90, from 12 pop.), †(25–)30–34(–42) × (4–)4.5–5(–5.5) µm (*n* = 114, from 12 pop.); cylindric-clavate, 8-spored, spores 2-seriate, *pars sporifera* *11–20 µm {12} long, pore amyloid in MLZ and LUG with or without KOH pre-treatment; arising from croziers. Ascospores *(6–)7–8(–9) × (1.5–)2–2.5 µm (*n* = 138, from 12 pop.), †5–7(–8) × 1.5–2 µm (*n* = 84, from 12 pop.); cylindric-subcylindric to slightly clavate, straight to slightly curved (allantoid), aseptate, hyaline, thin-walled, without guttules or some small ones in both extremes, f.g. (0–)1–2(–4) %. Paraphyses uninflated cylindric, 2- or 3-septate; terminal cell *(12–)15–19(–24) × 1.5–2 µm {12}, cell below *(5.5–)8–9.5(–11) × 1–2 µm {12}; simple to bifurcate near base, thin-walled, without guttules. Ectal excipulum at base and middle flanks *t. globulosa-angularis* to *t. prismatica*, *24.5–79 µm {6} thick; at margin and upper flank *t. prismatica*, *8.5–16.5 µm {6} thick; hyaline, not gelatinized, without crystals but with golden-yellow resinous exudate, amyloid nodules could be found in some populations. Ectal cells *(9–)10.5–12(–14.5) × (3.5–)5–6.5(–7.5) µm {12} at middle flank, wall thickness *0.5–1 µm; *(5–)6–8(–10.5) × (2–)3–3.5(–4.5) µm {12} at margin.

Distribution and ecology — The species has been reported in the N hemisphere in the Azores (Terceira), Canary Islands (Gomera, La Palma, Tenerife), Europe (Austria, Denmark, Finland, France, Germany, Lithuania, Norway, Portugal, Russia, Spain, Sweden, Switzerland, United Kingdom), Africa (Morocco), Asia (China, Japan, Philippines), North America (Canada, United States) and Central America (Jamaica). Growing on softwoods (*Abies* Mill., *Juniperus* L., *Larix* Mill., *Picea* A. Dietr., *Pinus* L., *Pseudotsuga* Carrière and *Taxus* L.). Occurring in all seasons, specially from summer to autumn (Huhtinen 1989; Galán & al. 1994; Zhuang 1995; Hansen & Knudsen 2000; Yu & al. 2000; Raitviir 2004; Kutorga & Raitviir 2006; GBIF 2015).

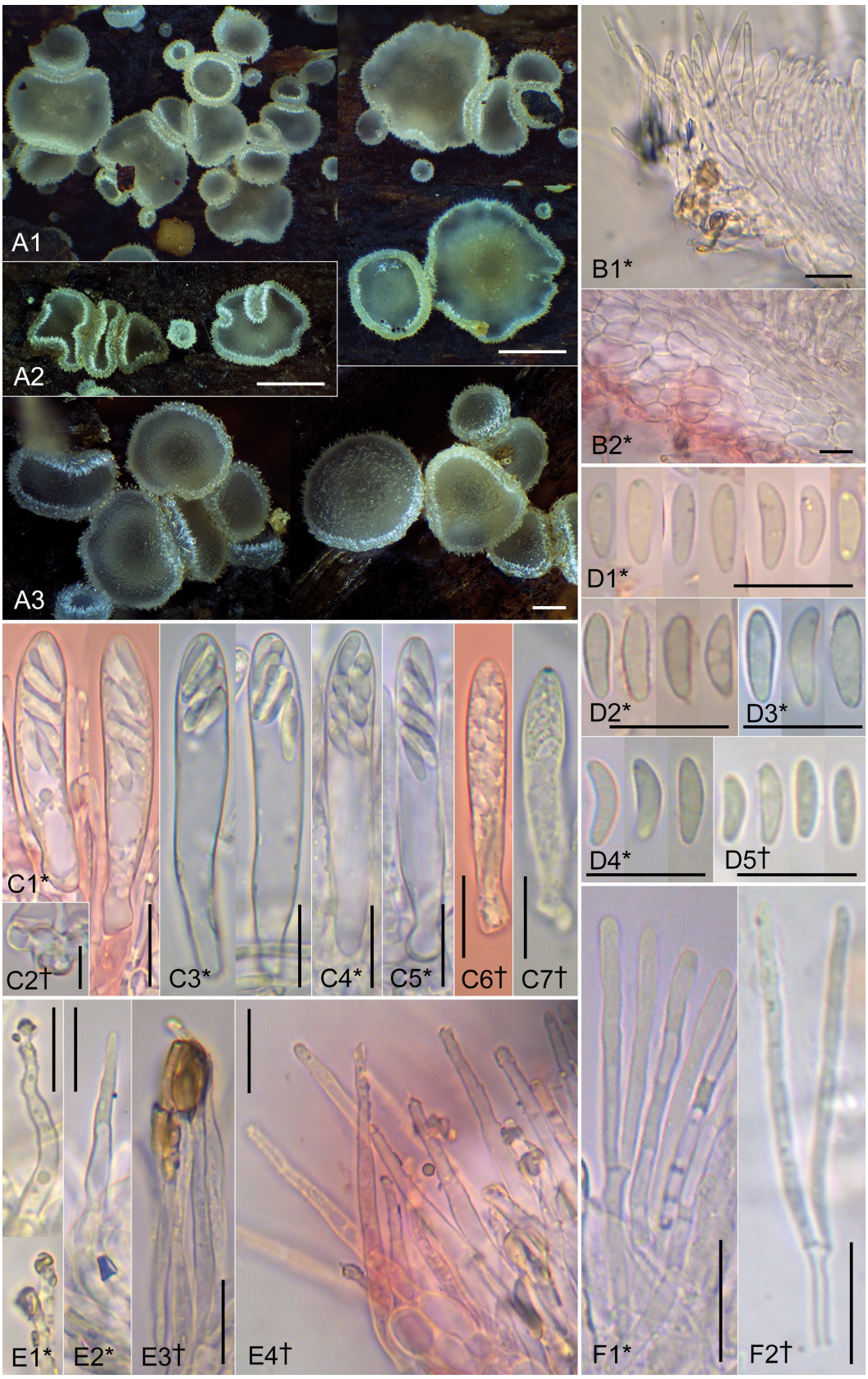

Fig. 1. Morphological features of *Hyaloscypha aureliella* – A: fresh apothecia; B: excipular tissues in section; C: asci; D: ascospores; E: hairs; F: paraphyses. – Scale bars: A1–2 = 500 µm; A3 = 100 µm; B1–2, C1–7, D1–5, E1–4, F1–2 = 10 µm. – Mounted in: B2, C1–2, C6, D1–2, E4 = CR; B1, C3–5, D3–4, E1–3, F1 = H_2O; D5, F2 = KOH; C7 = MLZ. – Photos: C1–2, C6, D1 = TFC Mic. 23297; D2–3 = TFC Mic. 23303; E3 = TFC Mic. 23344; B1, C7, F1 = TFC Mic. 23454; A3, C3 = TFC Mic. 23634; A2, B2, C4, D4, E4 = TFC Mic. 23931; A1, C5, D5, E1, F2 = TFC Mic. 24517.

Remarks — The Canary Islands material of this species was earlier wrongly reported under three different names, i.e. *Hyaloscypha fuckelii*, *H. hyalina* and *H. leuconica* (Beltrán-Tejera & al. 2004, 2008; Ribes 2009). The comparable *H. fuckelii* is recognized by its small spores and asci, combined with long thin-walled hairs (30–87 µm long, to 1 µm wide at apex). *Hyaloscypha leuconica* also has long hairs (50–250 µm long), but the wall is thick and it presents a dextrinoid reaction, hence it was transfered to *Hyalopeziza* Fuckel by Raitviir (2004). Neither species has resinous exudate on the hairs. *Hyaloscypha hyalina* was treated as a nomen confusum by Huhtinen (1989) because of the lack of a type specimen and the vagueness of its diagnosis. If neotypified, it should perhaps be linked either to *H. daedalea* Velen. or *H. quercicola* (Velen.) Huhtinen, because the only useful character in the original diagnosis is oak as the substrate (Huhtinen 1989).

All specimens were collected in pine forests on *Pinus* wood except one collection (TFC Mic. 24101), and all have blunt hairs with resinous exudate and without dextrinoid reaction, and non-guttulate cylindric to suballantoid ascospores, which fit perfectly in *Hyaloscypha aureliella*. The short description in Beltrán-Tejera & al. (2004, 2008) did not remark on the characteristics of hairs, but her personal notes and drawings showed the resinous exudate over the hairs, microscopically confirmed after the revision of the samples (Fig. 5). *Hyaloscypha aureliella* may be confused with *H. fuckelii* if no attention is paid to the resinous granules in the hairs, which can happen when the sample is mounted in a medium that disolves the resinous matter, but another feature helping the distinction is the presence of amyloid nodules in the excipulum of *H. aureliella* (but only in c. 30 % of the populations). In Ribes (2009), the resinous exudate was observed, but the sample was erroneously identified as *H. fuckelii* (Fig. 5).

Specimens studied — Spain: Canary Islands: La Palma: El Paso, La Caldera de Taburiente National Park, near to Lomo de los Juncos, 28°42'28"N, 17°51'09"W, 1250 m, typical Canary pine woodland, on *Pinus canariensis*, 4 Mar 2002, *E. González & al.* (TFC Mic. 12168). — Tenerife: Candelaria, Lomo Colorado, 28°24'37"N, 16°24'21"W, 1430 m, humid Canary pine woodland, idem, 30 Nov 2013, *LQ & CQ* (TFC Mic. 24382, 24387, 24389); idem, 28 Dec 2013, idem (TFC Mic. 24434, 24436, 24437, 24438); idem, El Rosario, Montaña Grande, 28°25'51"N, 16°23'05"W, 1200 m, typical Canary pine woodland, idem, 3 Oct 2012, idem (TFC Mic. 23588, 23590, 23595, 23597, 23598); idem, 20 Sep 2013, idem (TFC Mic. 24283); idem, La Laguna, Anaga Rural Park, Hija Cambada, 28°31'44"N, 16°17'10"W, 845 m, humid evergreen laurel forest, on *Morella faya*, 18 Apr 2013, idem (TFC Mic. 24101); idem, La Matanza de Acentejo, Montaña la Morra, 28°24'40"N, 16°24'59"W, 1520 m, humid Canary pine woodland, on *P. canariensis*, 3 Oct 2012, idem (TFC Mic. 23623, 23624); idem, La Orotava, Teide National Park, Corral Nuevo, 28°18'33"N, 16°34'01"W, 2000 m, Canary pine woodland with summit brooms, idem, 12 Oct 2012, idem (TFC Mic. 23647); idem, 28 Mar 2013, idem (TFC Mic. 23989, 23990); idem, Cueva los Lajones, 28°19'51"N, 16°29'37"W, 2060 m, idem, on planted *P. pinaster*, 23 Mar 2014, *LQ, CQ & RN* (TFC Mic. 24517); idem, La Orotava, Escobón Cortado, 28°19'51"N, 16°31'51"W, 1585 m, typical Canary pine woodland, on *P. canariensis*, 19 Dec 2011, *LQ & CQ* (TFC Mic. 23297, 23298); idem, Lomo Chillero, 28°21'19"N, 16°30'51"W, 1185 m, humid Canary pine woodland, idem, 16 Jan 2012, idem (TFC Mic. 23319, 23320, 23322, 23323, 23324); idem, 17 May 2012, idem (TFC Mic. 23450, 23452); idem, Lomo Tieso, 28°19'08"N, 16°33'29"W, 1785 m, typical Canary pine woodland, idem, 4 Dec 2011, idem (TFC Mic. 23283, 23285); idem, 12 Oct 2012, idem (TFC Mic. 23660); idem, 28 Mar 2013, idem (TFC Mic. 24006), idem, Montaña de Joco, 28°22'09"N, 16°27'56"W, 1940 m, Canary pine woodland with summit brooms, idem, 26 Sep 2012, idem (TFC Mic. 23577); idem, Montaña los Escodesos, 28°20'46"N, 16°31'04"W, 1430 m, humid Canary pine woodland, idem, 19 Dec 2011, idem (TFC Mic. 23300, 23301, 23303, 23305); idem, 17 May 2011, idem (TFC Mic. 23470, 23471, 23472); idem, Vilaflor, Las Lajitas, 28°09'34"N, 16°37'54"W, 1435 m, typical Canary pine woodland, idem, 19 Apr 2012, idem (TFC Mic. 23634); idem, Lomo Gordo, 28°10'09"N, 16°38'11"W, 1590 m, idem, 3 Feb 2012, idem (TFC Mic. 23344); idem, La Montañeta, 28°10'21"N, 16°38'49"W, 1790 m, idem, 9 Mar 2013, idem (TFC Mic. 23931).

Previously reported specimens reviewed and corrected — Spain: Canary Islands: La Palma: El Paso, La Caldera de Taburiente National Park, near to Bco. Ribanceras, 28°42'28"N, 17°51'09"W, 1250 m, typical Canary pine woodland, on *Pinus canariensis*, 4 Mar 2002, *E. González & al.* (TFC Mic. 12151, 12203, reported as *Hyaloscypha hyalina* in Beltrán-Tejera & al. 2004). — Gomera: Alajeró, Garajonay National Park, Hacia Igualero, 28°05'58"N, 17°14'41"W, 1310 m, *P. canariensis* plantations, idem, 16 Apr 2000, *EBT & al.* (TFC Mic. 14404, reported as *H. leuconica* in Beltrán-Tejera & al. 2008); idem, near to Hoya de los Cardos y a Eretos, 28°05'46"N, 17°14'37"W, 1325 m, idem, 10 Dec 2000, idem (TFC Mic. 11948, reported as *H. leuconica* in Beltrán-Tejera & al. 2008); idem, Vallehermoso, near to Igualero, 28°06'09"N, 17°15'07"W, 1350 m, idem, 16 Apr 2000, idem (TFC Mic. 14389, reported as *H. leuconica* in Beltrán-Tejera & al. 2008); idem, Los Ramones, camino Cruz de María a Igualero, 28°06'13"N, 17°15'35"W, 1170 m, *Chamaecytisus proliferus* scrubland, idem, 19 Jan 2001, *EBT & al.* (TFC Mic. 14385, reported as *H. leuconica* in Beltrán-Tejera & al. 2008); idem, San Sebastián de la Gomera, near to Los Roques, bajada a La Faja, 28°06'23"N, 17°12'27"W, 945 m, *P. canariensis* plantations, idem, 1 Feb 2002, idem (TFC Mic. 12027, reported as *H. leuconica* in Beltrán-Tejera & al.

2008). — Tenerife: La Orotava, Hoya Domingo Antonio, 28°21'36"N, 16°30'00"W, 1100 m, mixed plantations of *P. canariensis* and *P. halepensis*, on *Pinus* sp., 22 Dec 2008, *J. Caridad & al.* (herb. Ribes 221208 112, reported as *H. fuckelii* in Ribes 2009).

Hyaloscypha intacta Svrček in Česká Mykol. 40: 209. 1986. – Fig. 2.

Description — Fresh apothecia 0.1–0.4 mm in diam., to 0.1 mm high, scattered, not erumpent, sessile, white (263. White) to yellow-grey (93.yGrey), bordered by a narrow zone of marginal hairs. Hairs hyaline, narrowly conic, usually with apical solidification, 0- or 1-septate, straight to slightly sinuous; surface smooth, without changes in CR, KOH, LUG or MLZ; at upper flank *27–31 µm long, *2.6–3.1 µm wide at base, at margin *(17.5–) 22.5–32.5(–37.5) µm long, *2.5–3.5 µm wide at base; apex tapering to *0.5–1 µm wide. Asci *(61–)66–75(–84.5) × 7.5–9 µm (*n* = 10, from 1 pop.), †(43–)48.5–56.5(–58.5) × (4.5–)5.5–6.5(–7) µm (*n* = 10, from 1 pop.); cylindric-clavate, 8-spored, spores irregular 2- or 3-seriate, *pars sporifera* *23–31 µm long, pore inamyloid in MLZ and LUG with or without KOH pre-treatment; arising from simple septa. Ascospores *(8–)9.5–13(–16.5) × 3–3.5 µm (*n* = 10, from 1 pop.), †(7.5–)8–10.5(–12.5) × 2–3 µm (*n* = 10, from 1 pop.); subcylindric-clavate to fusiform-clavate, straight to slightly bent (rarely sigmoid), aseptate (1-septate when over-mature), hyaline, thin-walled, 2 multiguttulate groups in each extreme, f.g. (20–)30–45(–60) %. Paraphyses uninflated, cylindric, 2–4-septate; terminal cell *(15.5–)16.5–20 × 1.5–2.5 µm, cell below *(6–)7.5– 12.5(–15) × 1.5–2 µm; simple to bifurcate near base, thin-walled, without guttules. Ectal excipulum at base and middle flanks *t. angularis* to *t. prismatica*, *10–21 µm thick; at margin and upper flank *t. prismatica*, *4.5–10 µm thick; hyaline to light brownish greyish (63.l.brGy), not gelatinized, without crystals or exudate. Ectal cells *(9–)10–12(–13) × (4–)5–8(–10) µm at middle flank, wall thickness to *0.5 µm; *(6–)7–8.5(–10) × (2.5–)3–4(–4.5) µm at margin.

Distribution and ecology — The species has been reported in the N hemisphere in Europe (Czech Republic, Denmark, Finland, France, Germany, Luxembourg, Spain, Sweden, Russia, Ukraine, United Kingdom) and in North America (Canada). Growing on hardwoods (*Betula* L., *Carpinus* L., *Castanea* Mill., *Populus* L., *Prunus* L., *Salix* L. and *Sorbus* L.), apparently also one stray collection on *Juniperus*. Occurring in all seasons, being more abundant from autumn to spring (Svrček 1986; Huhtinen 1989; Baral 1992; Hansen & Knudsen 2000; Baral & Marson 2005; Morozova 2014; GBIF 2015).

Remarks — The present description fits in very well with the consulted literature (Svrček 1986; Huhtinen 1989; Hansen & Knudsen 2000; Raitviir 2004; Morozova 2014). The main difference could be the slightly more fusiform-clavate morphology in the ascospores studied by us, which can be explained as an over-mature morphology before germination.

Specimen studied — Spain: Canary Islands: Tenerife: La Orotava, Lomo Chillero, 28°21'19"N, 16°30'51"W, 1185 m, humid Canary pine woodland, on *Erica arborea*, 18 Feb 2014, *RN* (TFC Mic. 24498).

Hyaloscypha spiralis (Velen.) J. G. Han & al. in Fungal Biol. 118: 161. 2014. – Fig. 3.

Description — Apothecia 0.3–0.5 mm in diam., to 0.2 mm high, scattered to subgregarious, not erumpent, subsessile, white (263.White) to greyish yellow (90. gy.Y), margin slightly hairy. Hairs hyaline, narrowly conic to lageniform, tapering into a blunt apex, seldom solidified, 0- or 1-septate, slightly curved to strongly circinnate at apex; surface smooth or with dispersed warts, not dissolving or changing in CR, KOH, LUG or MLZ; at upper flank *(18.5–)20–31.5(–34) µm {10} long, *(1.5–)2–4.5(–5) µm {10} wide at base, at margin *(15–) 27–32.5(–44) µm {10} long, *(1.5–)3–4(–5.5) µm {10} wide at base; apex tapering to *0.5–1(–2) µm {10} wide. Asci *(42.5–)54–58(–69.5) × (7–)8–9 µm (*n* = 114, from 10 pop.), †(30.5–)36.5–40.5(–44.5) × (4–)5–6(–7) µm (*n* = 57, from 10 pop.); cylindric-clavate, 8-spored, spores 2-seriate, *pars sporifera* *14–32 µm {10} long, pore amyloid in MLZ or LUG with or without KOH pre-treatment; arising from simple septa. Ascospores *(7.5–) 9–9.5(–10.5) × 2.5–3(–4) µm (*n* = 105, from 10 pop.), †(5.5–)6.5–7.5(–8.5) × 2–2.6 µm (*n* = 40, from 10 pop.); cylindric-ellipsoid, straight to slightly inequilateral (suballantoid), without septa, occasionally 1-septate when over-mature, hyaline, thin-walled, with 2 or 3(or 4) guttules (1–1.5 µm in diam.), f.g. (20–)30–45(–60) %. Paraphyses uninflated cylindric, 2- or 3-septate; terminal cell *(15.5–)22.5–28(–35.5) × 1.5–2.5 µm {10}, cell below *(7–)10.5–12.5(–15.5) × 1–2.5 µm {10}; simple to rarely branched, bifurcate at apex or near base, thin-walled, without guttules. Ectal excipulum at base and middle flanks *t. globulosa-angularis* to *t. prismatica*, *24–68 µm {10} thick; at margin and upper flank *t. prismatica*, *8–28 µm {10} thick; hyaline, not gelatinized, without crystals or exudate. Ectal cells *(10–)13.5–15.5(–20) × (4.5–)7–8(–11) µm {10} at middle flank, wall thickness *0.5–1 µm {10}; *(7.5–)10–12(–16) × (3–)3.5–4(–5) µm {10} at margin.

Distribution and ecology — The species has been reported in the N hemisphere in Europe (Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Luxembourg, Norway, Sweden, Switzerland, United Kingdom), Asia (Japan) and North America (Canada, Greenland). In the S hemisphere in Australia, New Zealand, and South America (Argentina, Chile).

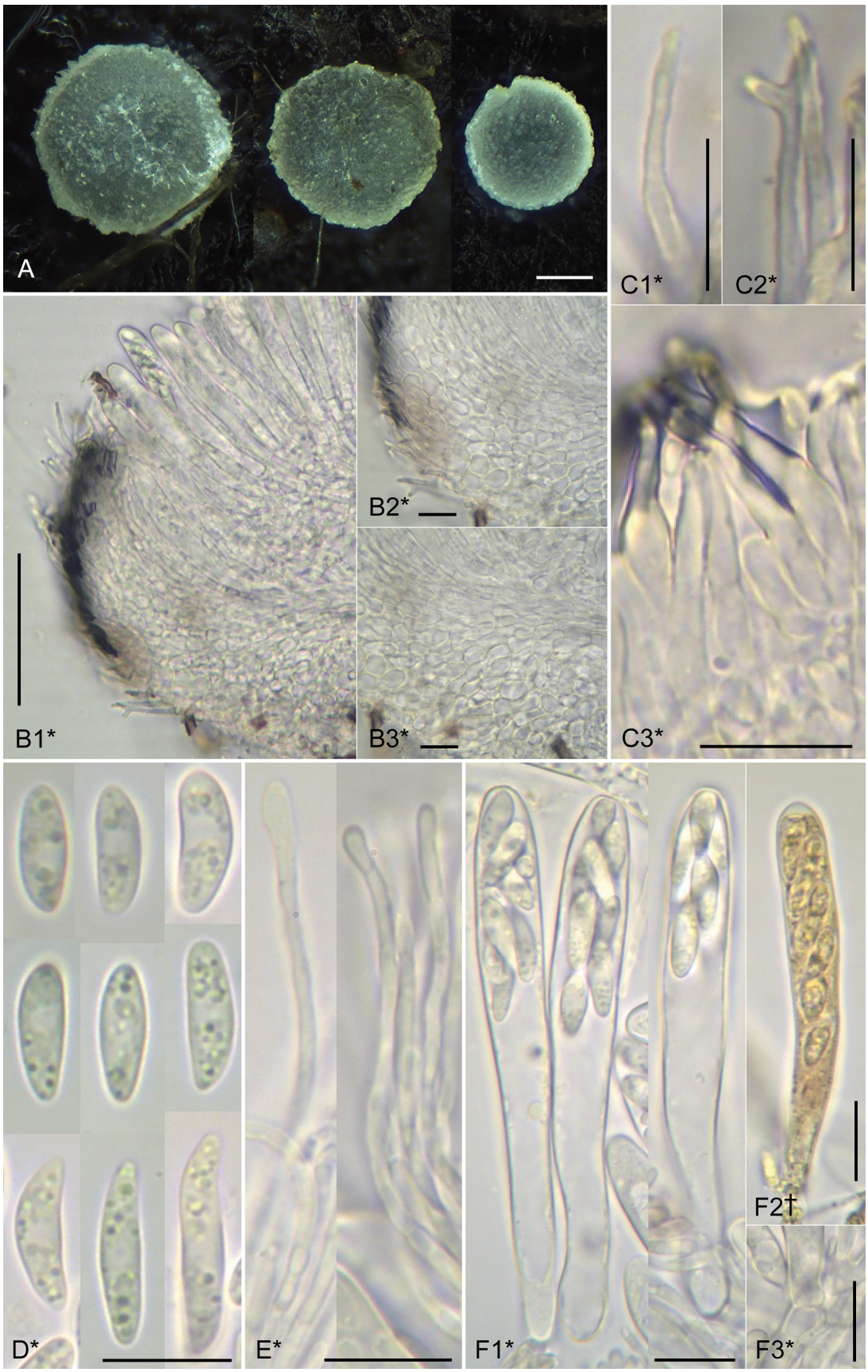

Fig. 2. Morphological features of *Hyaloscypha intacta* – A: fresh apothecia; B: excipular tissues in section; C: hairs; D: ascospores; E: paraphyses; F: asci. – Scale bars: A = 100 µm; B1 = 50 µm; B2–3, C1–3, D, E, F1–3 = 10 µm. – Mounted in: B1–3, C1–3, D, E, F1, F3 = H_2O; F2 = MLZ. – All photos from TFC Mic. 24498.

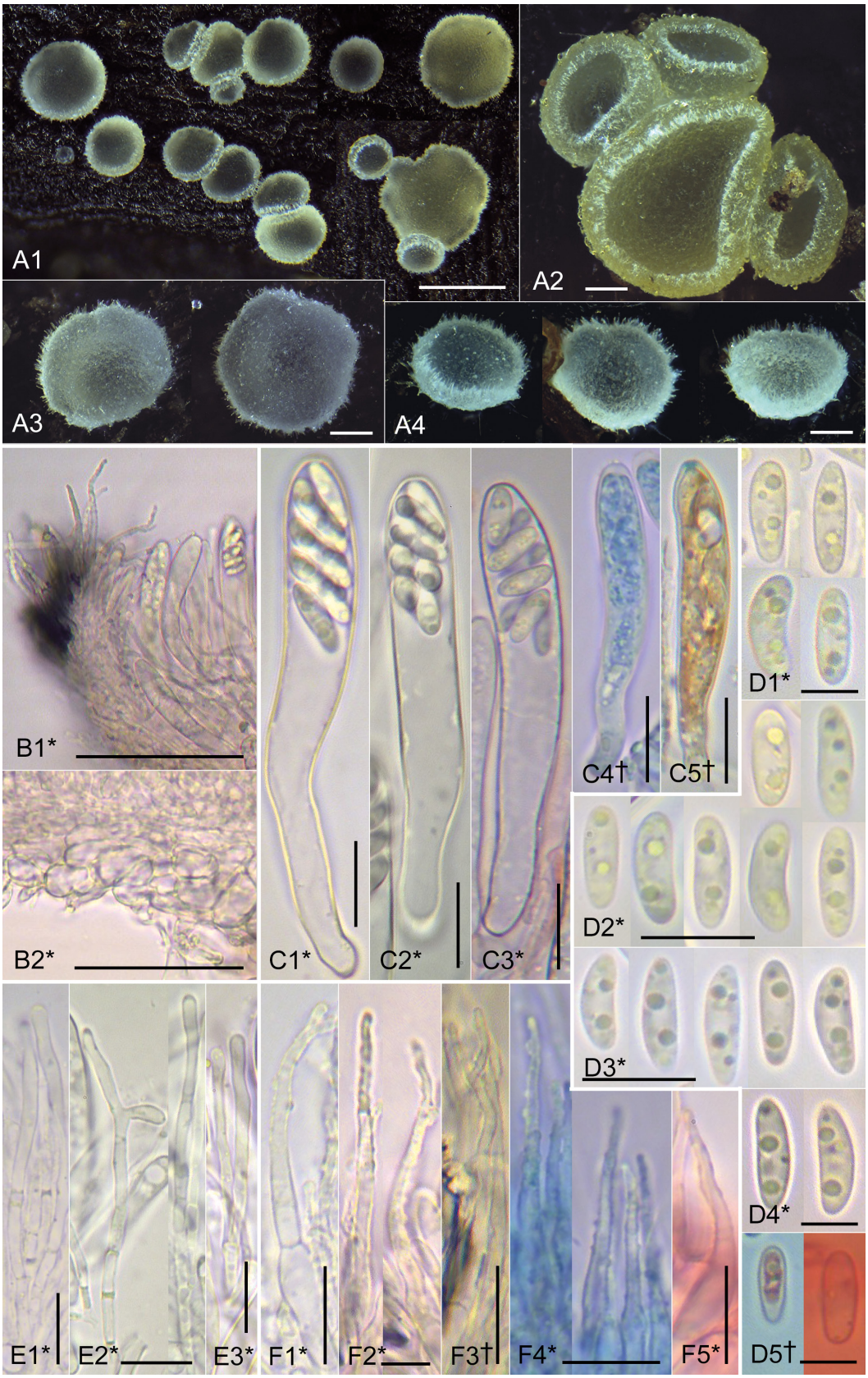

Fig. 3. Morphological features of *Hyaloscypha spiralis* – A: fresh apothecia; B: excipular tissues in section; C: asci; D: ascospores; E: paraphyses; F: hairs. – Scale bars: A1 = 500 µm; A2–4 = 100 µm; B1–2 = 50 µm; C1–5, D2–3, E1–3, F1, F3–5 = 10 µm; D1, D4–5, F2 = 5 µm. – Mounted in: C4, F4 = CB; C1, C3, D5, F5 = CR; B1–2, C2, D1–4, E1–3, F1–2 = H_2O; C5, F3 = MLZ. – Photos: A1, C3, F1 = TFC Mic. 23980; A2, C5, D1, E1, F3 = TFC Mic. 23405; A3, D2, F5 = TFC Mic. 23389; A4, D3 = TFC Mic. 24048; B1, C1, D4–5, E3, F2 = TFC Mic. 23438; B2, C4, F4 = TFC Mic. 24215; C2, E2 = TFC Mic. 23483.

Mainly growing on hardwoods (*Alnus* Mill., *Betula, Carpinus*, *Corylus* L., *Crataegus* L., *Fagus* L., *Fraxinus* Tourn. ex L., *Nothofagus* Blume, *Populus*, *Prunus*, *Quercus* L., *Salix*, *Sambucus* L. and *Ulex* L.), less frequently on softwoods (*Larix*, *Pinus*). The ecological amplitude is widened by stems of *Rubus* L. and *Sasa* Makino & Shibata, unidentified leaves, cupules of *Castanea*, cones of *Picea*, and old pyrenomycetous fruit bodies, as well as the substrates cited below. Occurring in all seasons, more abundantly from spring to autumn (Velenovský 1934; Huhtinen 1989; Raitviir 2004; GBIF 2015).

Remarks — *Hyaloscypha albohyalina* var. *spiralis* (Velen.) Huhtinen has been recently raised to species level, *H. spiralis* (Velen.) J. G. Han & al. (Han & al. 2014). It can be easily distinguished from the type variety, *H. albohyalina* var. *albohyalina* (P. Karst.) Boud., by the lack of croziers at the ascal base. The morphological and biometrical characteristics of the Canarian specimens (asci, ascospores, excipulum, paraphyses, hairs) fit well with the consulted literature (Velenovský 1934; Huhtinen 1989; Raitviir 2004).

Specimens studied — Spain: Canary Islands: La Palma: El Paso, La Caldera de Taburiente National Park, Hoyo Verde, 28°43'23"N, 17°52'56"W, 865 m, typical Canary pine woodland, on *Ageratina adenophora*, 5 Mar 2002, *EBT & al.* (TFC Mic. 12163). — Gomera: Hermigua, Garajona National Park, Cruce al Cedro, 28°07'18"N, 17°12'55"W, 1090 m, humid evergreen laurel forest, on *Morella faya*, 1 Dec 2002, *EBT & al.* (TFC Mic. 14336). Tenerife: Buenavista del Norte, Teno Rural Park, La Rife, 28°19'08"N, 16°49'42"W, 1090 m, substitutional vegetation "fayal-brezal", idem, 15 Apr 2012, *LQ & al.* (TFC Mic. 23438, 23441); idem, Güimar, Higueras Salvajes, 28°18'30"N, 16°27'03"W, 925 m, dry evergreen laurel forest, on *Arbutus canariensis*, 23 Mar 2012, *LQ & al.* (TFC Mic. 23978); idem, on *Picconia excelsa*, idem (TFC Mic. 23980); idem, Los Silos, Teno Rural Park, Lomo Alto, 28°20'04"N, 16°49'22"W, 750 m, idem, on *Laurus novocanariensis*, 4 May 2012, *LQ & CQ* (TFC Mic. 23482, 23483); idem, on *Erica arborea*, idem (TFC Mic. 23499); idem, Santa Cruz de Tenerife, Anaga Rural Park, Descansaderos de Tierra, 28°32'21"N, 16°13'25"W, 860 m, *Erica platycodon* ridge-crest evergreen forest, on *Morella faya*, 7 Mar 2012, idem (TFC Mic. 23389); idem, Piedra Chinobre, 28°33'30"N, 16°10'29"W, 900 m, idem, on *Laurus novocanariensis*, 7 Apr 2013, idem (TFC Mic. 24048); idem, Tegueste, Anaga Rural Park, Hoya Zapata, 28°31'51"N, 16°17'46"W, 820 m, humid evergreen laurel forest, idem, 22 Mar 2012, idem (TFC Mic. 23405); idem, on *Prunus lusitanica* subsp. *hixa*, 8 May 2013, idem (TFC Mic. 24215).

Previously reported specimens reviewed and corrected — Spain: Canary Islands: La Palma: El Paso, La Caldera de Taburiente National Park, Sendero de la Cumbrecita al Bco. de Las Verduras, Hoyo de los Pinos, 28°42'59"N, 17°50'48"W, 1380 m, typical Canary pine woodland, on *Cistus* sp., 17 Dec 2000, *EBT & al.* (TFC Mic. 10213, reported as *Hyaloscypha hyalina* in Beltrán-Tejera & al. 2004).

Hyaloscypha strobilicola Huhtinen in Karstenia 29(2): 170. 1989. – Fig. 4.

Description — Apothecia 0.1–0.2 mm in diam., to 0.1 mm high, sparse to densely gregarious, not erumpent, subsessile, white (263.White), densely hairy in margin and receptacle. Hairs hyaline, narrowly conic, aseptate, straight to apically slightly undulating; surface smooth, usually with apical incrustation of hyaline amorphous resinous matter, without changes in CR, KOH, LUG and dissolves in MLZ; at upper flank *(21.5–)23–28.5(–32.5) µm {4} long, *2–3.5 µm {4} wide at base, at margin *(21–)23.5–29.5(–34.5) µm {4} long, *2–3 µm {4} wide at base; apex tapering to *0.5–1 µm {4} wide. Asci *(30–)33–40(–47) × 4.5–5.5 µm (*n* = 40, from 4 pop.), †(21–)22–27(–29.5) × 3–4.5 µm (*n* = 36, from 4 pop.); cylindric-clavate, 8-spored, 2-seriate, *pars sporifera* *11–16 µm long, pore amyloid in MLZ and LUG with or without KOH pre-treatment; arising from croziers (or bifurcate base). Ascospores *4–5 × 1.5–2 µm (*n* = 40, from 4 pop.), †3–4.5 × 1–1.5 µm (*n* = 40, from 4 pop.); ellipsoid to subcylindric, straight to slightly inequilateral, aseptate, hyaline, thin-walled, not guttulate, f.g. 0–1 %. Paraphyses uninflated cylindric, 2- or 3-septate; terminal cell *(12–)13–16(–17.5) × 1–1.5 µm {4}, cell below *(6.5–)7.5–9.5(–11.5) × 1–2 µm {4}; simple to bifurcate near base, thin-walled, without guttules. Ectal excipulum from base to margin of *t. prismatica*, *25–30 µm {4} thick at base and middle flanks; *12–17 µm {4} thick at margin and upper flank; hyaline, not gelatinized, without crystals, but with hyaline and sparse resinous matter. Ectal cells *(6–)7–10(–11.5) × 3–4.5 µm {4} at middle flank, wall thickness *0.5–1 µm; *5.5–7.5(–9) × 2.5–3.5(–4) µm {4} at margin.

Distribution and ecology — The species has been found in the N hemisphere in Europe (Italy) and North America (United States). Growing on dead cone scales of *Pinus*. Occurring in autumn (Huhtinen 1989).

Remarks — *Hyaloscypha strobilicola* is easy to identify due to the ecology, i.e. growth on cone scales, and its morphology, i.e. minute apothecia with resinous matter in hairs, short amyloid asci with croziers, and small ascospores without guttules. The closest species is *H. aureliella*, but it has larger apothecia (0.2–0.5 mm vs 0.1–0.2 mm), hairs (to 44 µm vs *to 34.5 µm) and ascospores (*6–9 µm vs *4–5 µm). *Hyaloscypha strobilicola* had been found in the Canary Islands before this study, but the specimens were erroneously reported under *H. leuconica*. All the characters of our sample fit in well with the description of the holotype (Huhtinen 1989; Raitviir 2004).

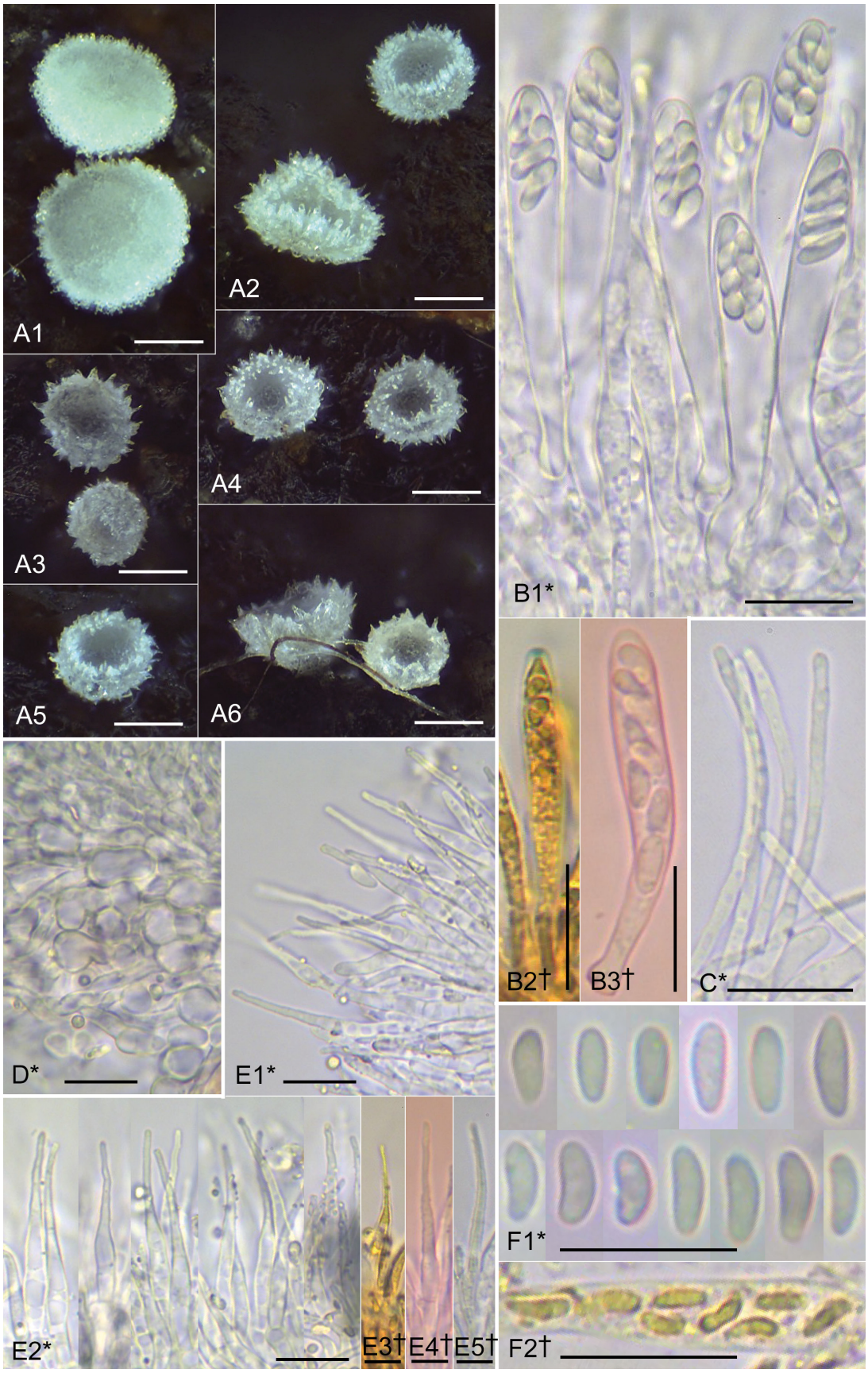

Fig. 4. Morphological features of *Hyaloscypha strobilicola* – A: fresh apothecia; B: asci; C: paraphyses; D: excipular tissues in section; E: hairs; F: ascospores. – Scale bars: A1–6 = 100 µm; B1–3, C, D, E1–2 = 10 µm; E3–4 = 5 µm. – Mounted in: B3, E4 = CR; B1, C, D, E1–2 = H_2O; E5 = KOH; B2, E3 = MLZ. – All photos from TFC Mic. 21420.

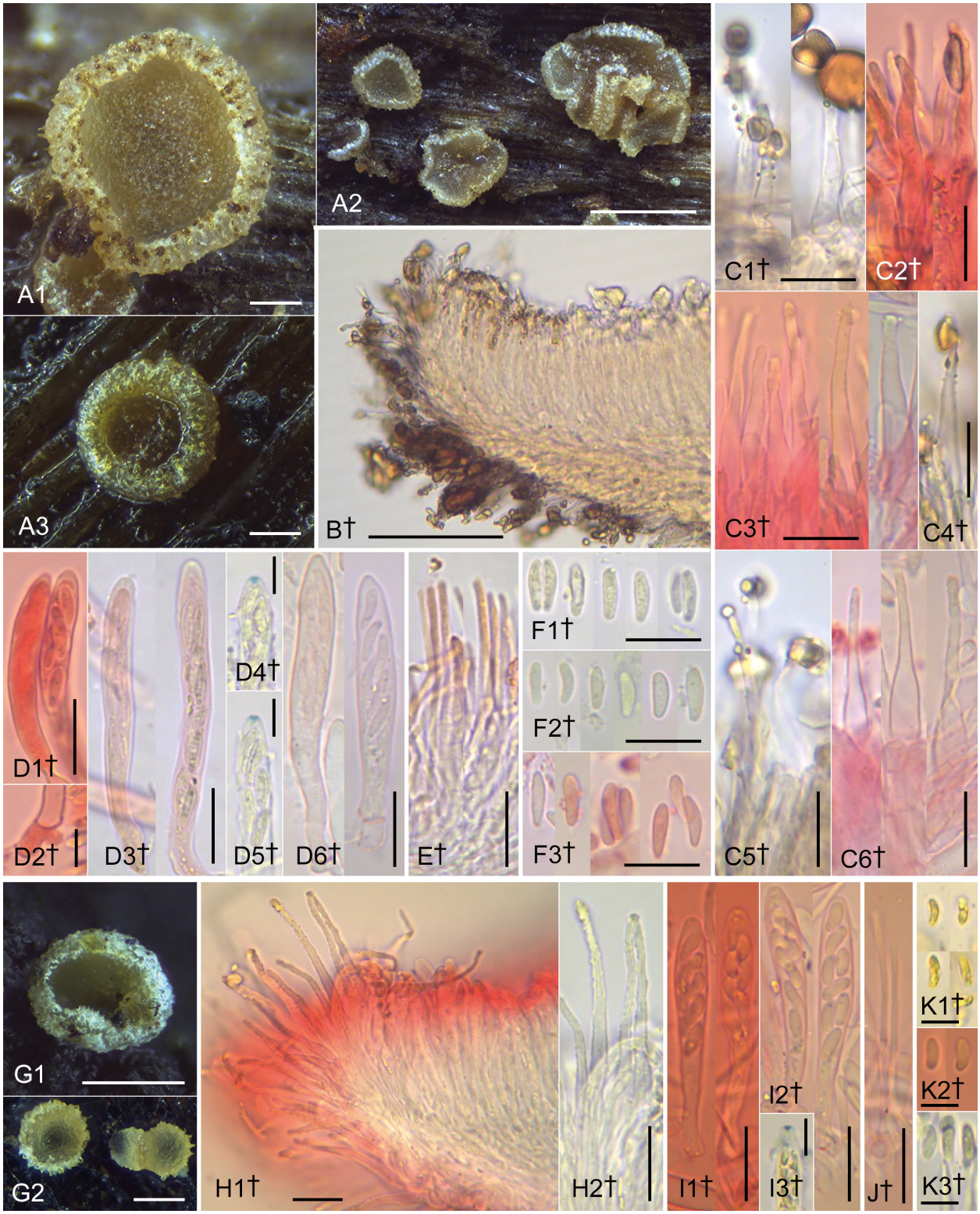

Fig. 5. A second look over specimens previously reported in the Canary Islands. – A–F: photos for corrected specimens of *Hyaloscypha aureliella* (previously identified as *H. fuckelii* and *H. hyalina*); A: rehydratated apothecia; B: transverse section of apothecium showing brownish yellow resin; C: hairs; D: asci; E: paraphyses; F: ascospores. – G–K: photos for corrected specimens of *Hyaloscypha strobilicola* (previously identified as *H. leuconica*); G: rehydratated apothecia; H: transverse section and hairs; I: asci; J: paraphyses; K: ascospores. – Scale bars: A2 = 500 µm; A1, A3, G1–2 = 100 µm; B = 50 µm; C1–6, D1, D3, D6, E, F1–3, H1–2, I1–2, J = 10 µm; D2, D4–5, I3, K1–3 = 5 µm. – Mounted in: C2–3, C6, D1–3, D6, E, F3, H1, I1–2, J, K2 = KOH+CR; B, C1, C4–5, F1, H2, K3 = H_2O; F2 = KOH; D4–5, I3, K1 = MLZ. – Photos from: G1, H1–2, I2–3, J, K1–3 = TFC Mic. 10217; G2, I1 = TFC Mic. 10197; A3, C5–6, F3 = TFC Mic. 12151; C3–4, D6, F2 = TFC Mic. 12203; A1–2, B, C1–2, D1–5, E, F1 = Herb. Ribes 221208.

Specimen studied — Spain: Canary Islands: Tenerife: La Matanza de Acentejo, Montaña la Morra, 28°24'40"N, 16°24'59"W, 1520 m, humid Canary pine woodland, on detached cone scales of *Pinus canariensis*, 20 Jun 2014, *M. Ribes, RN & LQ* (TFC Mic. 21420).

Previously reported specimens reviewed and corrected — Spain: Canary Islands: Gomera: Alajeró, Garajonay National Park, near to Hoya de los Cardos and to Eretos, 28°05'46"N, 17°14'37"W, 1325 m, *Pinus canariensis* plantations, on detached cone scales of *P. canariensis*, 10 Dec 2000, *EBT & al.* (TFC Mic. 11946, reported as *Hyaloscypha leuconica* in Beltrán-Tejera & al. 2008). — La Palma: El Paso, La Caldera de Taburiente National Park, Sendero to Cumbrecita to Barranco de Las Verduras, Galería de La Faya, 28°42'52"N, 17°50'54"W, 1175 m, typical Canary pine woodland, idem, 17 Dec 2000, idem (TFC Mic. 10217, reported as *H. leuconica* in Beltrán-Tejera & al. 2004); idem, Tijarafe, El Riachuelo, 28°41'31"N, 17°57'13"W, 1230 m, Canary pine woodland mixed with *Ficus carica* plantations, idem, 17 Dec 2000, idem (TFC Mic. 10197, reported as *H. leuconica* in Beltrán-Tejera & al. 2004).

Discussion

Our revision of the genus *Hyaloscypha* in the Canary Islands showed that all species previously reported (*H. fuckelii*, *H. hyalina* and *H. leuconica*) have been erroneously identified (Fig 5). None of the taxa treated in this paper had been reported before in the archipelago. The ecology of the Canarian specimens agrees with the general knowledge reported before for each species (Huhtinen 1989). *Hyaloscypha spiralis* has been reported mainly on hardwoods, occurring more abundantly from spring to autumn. In the Canarian archipelago it follows the same pattern, but its development seems to be mainly restricted to one type of vegetation (laurel forest), and here it is reported for the first time on the following hardwoods: *Arbutus* L., *Erica* L., *Laurus* L., *Morella* Lour. and *Picconia* DC. Its phenology is shorter than previously reported, restricted mainly to the spring. As Huhtinen (1989) indicated in his monograph, *H. aureliella* is a very common species restricted mainly to softwoods, which is the case also in the Canarian archipelago. Although the phenology of the species is different in the temperate and boreal zones, the peak of fruiting is reached between summer and autumn. In the Canary Islands this peak is reached in the period of maximum rainfall and mild temperatures, between autumn and spring. In summer, in the dry period with high temperatures, only one specimen was found. For *H. intacta* and *H. strobilicola*, we have too few collections to permit remarks on its phenology. *Hyaloscypha intacta* grows on hardwoods, and here we widen its distribution to lower latitudes.

All the specimens collected in the Canary Islands have been found in laurel or pine forests in middle elevations, between 750 m and 2060 m. In some species, substrate plays a major role independently from climatic conditions, such as in *Hyaloscypha aureliella* (*Pinus* wood) or *H. strobilicola* (cone scales). On the other hand, *H. spiralis* grows independently from the substrate, and is linked to the most humid areas influenced by the trade winds.

Key to *Hyaloscypha* in the Canary Islands (based on living material)

1. Asci inamyloid . . . . . ***Hyaloscypha intacta***
– Asci amyloid **2**
2. Ascospore mean length < 5.5 µm . . . . . ***Hyaloscypha strobilicola***
– Ascospore mean length > 5.5 µm **3**
3. Hairs with amber-coloured resinous matter; ascospore mean width < 2.5 µm, usually without drops (rarely with tiny drops, to 0.5 µm in diam.) . . . . . ***Hyaloscypha aureliella***
– Hairs without amber resinous matter; ascospore mean width > 2.5 µm, always with 2 or 3(or 4) large drops (1–1.5 µm in diam.) . . . . . ***Hyaloscypha spiralis***

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