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Crystallodon Alvarenga gen. nov., a new genus of the Auriculariales from the Neotropics

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ABSTRACT
Heterochaete subgelatinosa Bodman (Auriculariales, Basidiomycota) was first described from material collected in Panama and was hitherto exclusively known from the type locality. We recently re-collected specimens of this species in the Atlantic forest of North-eastern Brazil. Morphological and molecular data suggest that *H. subgelatinosa* is not closely related to other species of *Heterochaete* Pat. studied with modern methods. Therefore, we here propose the establishment of a new monotypic genus, *Crystallodon* Alvarenga gen. nov., characterized by the presence of hyphal pegs surrounded by crystals.

KEY WORDS
Basidiomycota, Agaricomycetes, tropical forest, rDNA phylogeny, new combination, new genus.

RÉSUMÉ
Crystallodon *Alvarenga gen. nov., un nouveau genre des Auriculariales des Néotropiques.*
Heterochaete subgelatinosa Bodman (Auriculariales, Basidiomycota) a été décrite pour la première fois à partir de matériel collecté au Panama et était jusqu'ici exclusivement connu de la localité type. Nous avons récemment recollecté des spécimens de cette espèce dans la forêt atlantique du nord-est du Brésil. Les données morphologiques et moléculaires suggèrent que *H. subgelatinosa* n'est pas étroitement apparenté aux autres espèces d'*Heterochaete* Pat. étudiées avec des méthodes modernes. Par conséquent, nous proposons ici la création d'un nouveau genre monotypique, *Crystallodon* Alvarenga gen. nov., caractérisé par la présence de chevilles d'hyphe entourées de cristaux.

MOTS CLÉS
Basidiomycota, Agaricomycetes, forêts tropicales, phylogénie de l'ADNr, combinaison nouvelle, genre nouveau.

INTRODUCTION

Currently, the order Auriculariales includes saprophytic species with resupinate, effused-reflexed, hydnoid, cerebriform, coralloid, or pileate basidiomata (Wells & Bandoni 2001; Hibbett *et al.* 2014), possessing "complex septal pores with imperforate caps (dolipores with continuous parenthesomes), transversely, obliquely to longitudinally, or even partially septate basidia, and basidiospores that are generally capable of germinating with the development of hyphae, secondary ballistospores, or microconidia" (Wells & Bandoni 2001). Therefore, the delimitation of Auriculariales was principally based on the characteristics observed under optical and electron microscopy, but was since also supported by molecular analyses (Weiss & Oberwinkler 2001; Malysheva & Spirin 2017; Spirin *et al.* 2019a, b).

However, the hymenophores of resupinate Auriculariales may vary from smooth, tuberculate, and hydnoid to papillate, in a way that does not reflect lineages within Auriculariales, as some genera include species with different types of hymenophores (e.g. *Adustochaete* Alvarenga & K.H.Larss., *Eichleriella* Bres., *Protomerulius* Möller) (Malysheva & Spirin 2017; Alvarenga *et al.* 2019; Spirin *et al.* 2019b). Moreover, species with sterile spines (hyphal pegs) have so far been described in genera such as *Eichleriella*, *Heterochaete* Pat., *Heteroradulum* Lloyd ex Spirin & Malysheva, *Proterochaete* Spirin & V. Malysheva, *Adustochaete* and *Metulochaete* Alvarenga (Bodman 1952; Malysheva & Spirin 2017; Alvarenga *et al.* 2019; Spirin *et al.* 2019a, b).

Recently, several genera and species of resupinate Auriculariales with hyphal pegs have been described or better defined using morphological and molecular analyses, showing the hidden diversity of this group (Malysheva & Spirin 2017; Alvarenga *et al.* 2019; Spirin *et al.* 2019a, b). Similarly, we report here that during a survey in areas of the Atlantic rain forest, interesting specimens of resupinate Auriculariales with hyphal pegs covered by crystals were morphologically identified as *Heterochaete subgelatinosa* Bodman, but they showed to be a distinct lineage within the order when genetically analysed.

MATERIAL AND METHODS

Sampling and morphologic characterization

The specimens were collected during the rainy season of 2018, in two areas of the Atlantic rain forest in the state of Pernambuco: the Reserva Biológica de Saltinho (9°16'37"S, 35°10'46"W), and an urban, secondary forest belonging to the Army (8°00'06.4"S, 34°51'26.1"W). Microscopical studies were carried out with samples mounted in 3% KOH + 1% phloxine and Cotton Blue. Measures were conducted according to Miettinen *et al.* (2012). The following abbreviations were used in morphological descriptions and tables: L = mean spore length, W = mean spore width, Q' = length/width ratio, Q = mean length/width ratio, n = number of measurements per specimen. Colours were compared to a fungal colour chart (Kornerup & Wanscher 1978) and identification was carried out according to Bodman (1952); Viégas (1945); Lowy (1971, 1976, 1977, 1987) and Roberts (2003, 2006, 2008). The specimens were deposited in the Herbarium of the Departamento de Micologia, UFPE (URM) (Thiers 2016).

DNA extraction, PCR, sequencing and phylogenetic analyses

DNA extraction was performed with the DNeasy Plant Mini Kit (Qiagen), following the manufacturer's protocol. Polymerase chain reaction (PCR) was performed with the extracted DNA targeting the nuclear rDNA internal transcribed spacers (ITS1-5.8 S-ITS2 = ITS) and nuclear rDNA large subunit (LSU, 28S). For the ITS region we used the primers ITS1F-ITS4 (White *et al.* 1990; Gardes & Bruns 1993), whereas LR0R and LR5 (Vilgalys & Hester 1990) were used to amplify the D1/D2 domains of the 28S rRNA.

PCR products were purified with the ExoSAP-IT PCR Product Cleanup kit (Thermo Fisher Scientific). The sequences were provided by the Plataforma Tecnológica de Genômica e Expressão Gênica do Centro de Biociências (UFPE).

The assembly and editing of sequences were performed with the Staden Package 2.0 software (Staden *et al.* 1998) and MEGA 6 (Tamura *et al.* 2013). Sequences were compared with sequences deposited in GenBank (https://www.ncbi.nlm.nih.gov/genbank/). The sequences generated in this study were also deposited in GenBank under accession number: MN475887, MN475888, MN475889, MN475890 (LSU) and MN475884, MN475885, MN475886 (ITS) (Table 1).

Following Malysheva *et al.* (2018), *Sistotrema brinkmannii* (Bres.) J. Erikss. (JX535170/JX535169) was used as an outgroup in phylogenetic analyses. Sequence alignments were constructed with the online version of MAFFT (Katoh & Toh 2008), using the Q-INS-I option with default parameters to include representatives of multiple genera of Auriculariales (Table 1).

Phylogenetic reconstructions were inferred from Maximum Likelihood (ML) and Bayesian Inference (BI) methods. The best evolutionary model was estimated for each dataset based on the Akaike Information Criterion using ModelTest on TOPALi 2.5. In ML and BI analyses for the ITS + 28S dataset, the model employed was GTR + G + I.

ML analysis was run with PhyML (Guindon & Gascuel 2003), with 100 rapid bootstrap replicates, while BI analysis was performed using MrBayes v.3.2.6 (Ronquist & Huelsenbeck 2003) for two independent runs, each run for six million generations with four chains. Both analyses were carried out with the software TOPALi 2.5.

Phylogenetic analyses

Phylogenetic reconstruction was based on the alignment of the ITS + 28S dataset with 1808 characters, including gaps, of sequences representing 26 already described genera belonging to Auriculariales. ML and BI analyses produced trees with nearly congruent topologies and therefore only the BI tree is shown here (Fig. 1). The sequences from the studied specimens were grouped within one clade (bp = 93, pp = 1), that we interpret as a new lineage in Auriculariales. The new genus

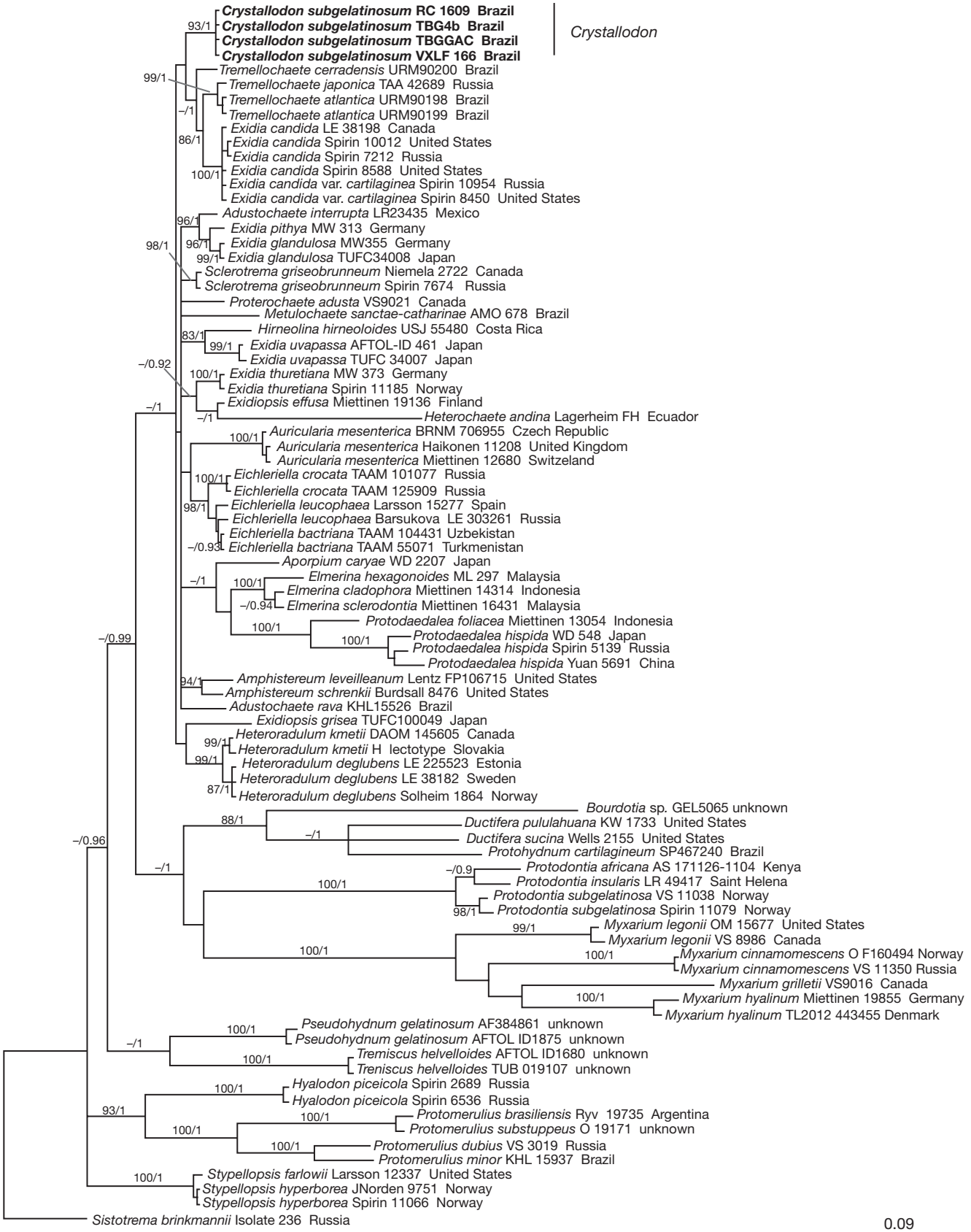

Fig. 1. — Phylogenetic reconstruction using ITS + 28S rDNA topology from BI analysis showing the lineages of Auriculariales. All sequences generated in this study are indicated in **bold**. The voucher or GenBank accession number and country, when available, are given for each specimen. Support values (ML/BI) are indicated above the branches. Scale bar shows the number of expected changes per site.

TABLE 1. — Collection information and GenBank accecion numbers used in the present phylogenetic study. Newly generated sequences are highlighted in **bold**.

Taxa	Voucher	GenBank accecion numbers nLSU	nITS	References
Adustochaete interrupta Spirin & V. Malysheva	LR23435	MK391527	MK391518	Alvarenga *et al.* (2019)
Adustochaete rava Alvarenga & K.H.Larss	KHL15526	MK391526	MK391517	Alvarenga *et al.* (2019)
Amphistereum leveilleanum (Berk. & M.A.Curtis) Spirin & Malysheva	Lentz FP 106715	KX262168	KX262119	Malysheva & Spirin (2017)
Amphistereum schrenkii (Burt) Spirin & V. Malysheva	Burdsall 8476	KX262178	KX262130	Malysheva & Spirin (2017)
Aporpium caryae (Schweinitz) Teixeira & D.P. Rogers	WD 2207	AB871730	AB871751	Sotome *et al.* (2014)
Auricularia mesenterica (Dickson) Persoon	BRNM 706955	KP729296	KP729278	Wu *et al.* (2015)
Auricularia mesenterica	Miettinen 12680	KP729304	KP729286	Wu *et al.* (2015)
Auricularia mesenterica	Haikonen 11208	KP729305	KP729287	Wu *et al.* (2015)
Bourdotia sp.	GEL5065	AY635777	DQ200925	GenBank
Crystallodon subgelatinosum (Bodman) Alvarenga & Gibertoni, comb. nov.	**VXLF 166-URM93443**	**MN475887**	**–**	This study
Crystallodon subgelatinosum comb. nov.	**RC 1609 - URM93444**	**MN475888**	**MN475884**	This study
Crystallodon subgelatinosum comb. nov.	**TBG BF-18001-URM93445**	**MN475889**	**MN475885**	This study
Crystallodon subgelatinosum comb. nov.	**TBG 4b - URM93446**	**MN475890**	**MN475886**	This study
Ductifera pululahuana (Pat.) Donk	KW 1733	AF291315	-	Weiss & Oberwinkler (2001)
Ductifera sucina (Möller) K. Wells	Wells 2155	AF291316	-	Weiss & Oberwinkler (2001)
Eichleriella bactriana Spirin & Malysheva	TAAM 55071	KX262170	KX262121	Malysheva & Spirin (2017)
Eichleriella bactriana	TAAM 104431	KX262186	KX262138	Malysheva & Spirin (2017)
Eichleriella crocata (Pat.) Spirin & V. Malysheva	TAAM 101077	KX262147	KX262100	Malysheva & Spirin (2017)
Eichleriella crocata	TAAM 125909	KX262167	KX262118	Malysheva & Spirin (2017)
Eichleriella leucophaea Bres.	Barsukova LE 303261	KX262161	KX262111	Malysheva & Spirin (2017)
Eichleriella leucophaea	Larsson 15277	KX262164	KX262115	Malysheva & Spirin (2017)
Elmerina cladophora (Berk.) Bres.	Miettinen 14314	MG757509	MG757509	Malysheva *et al*. (2018)
Elmerina hexagonoides (A. David & Jaq.) Núñez	ML 297	AB871735	AB871754	Sotome *et al.* (2014)
Elmerina sclerodontia (Mont. & Berk.) Miettinen & Spirin	Miettinen 16431	MG757512	MG757512	Malysheva *et al*. (2018)
Exidia candida Lloyd	LE 38198	KY801896	KY801871	Spirin *et al* (2018)
Exidia candida	Spirin 8588	KY801895	KY801870	Spirin *et al* (2018)
Exidia candida	Spirin 10012	KY801890	KY801865	Spirin *et al* (2018)
Exidia candida	Spirin 7212	KY801891	KY801866	Spirin *et al* (2018)
Exidia candida var. *cartilaginea* (S. Lundell & Neuhoff) Spirin & Malysheva	Spirin 8450	KY801900	KY801875	Spirin *et al* (2018)
Exidia candida var. *cartilaginea*	Spirin 10954	KY801901	KY801876	Spirin *et al* (2018)
Exidia glandulosa (Bull.) Fr.	MW355	AF291319	AF291273	Weiss & Oberwinkler (2001)
Exidia glandulosa	TUFC34008	AB871742	AB871761	Sotome *et al.* (2014)
Exidia pithya (Alb. & Schwein.) Fr.	MW 313	AF291321	AF291275	Weiss & Oberwinkler (2001)
Exidia thuretiana (Lév.) Fr.	Spirin 11185	KY801914	KY801889	Weiss & Oberwinkler (2001)
Exidia thuretiana	MW 373	AF291324	AF291278	Weiss & Oberwinkler (2001)
Exidia uvapassa Lloyd	AFTOL ID 461	AY645056	DQ241776	GenBank
Exidia uvapassa	TUFC 34007	AB871744	AB871763	GenBank
Exidiopsis effusa (Bref. ex Sacc.) Möller	Miettinen 19136	KX262193	KX262145	Malysheva & Spirin (2017)
Exidiopsis grisea (Bres.) Bourdot & Maire	TUFC100049	AB871746	AB871765	Sotome *et al.* (2014)
Heterochaete andina Pat. & Lagerh.	Lagerheim FH	KX262187	–	Malysheva & Spirin (2017)
Heteroradulum deglubens (Berk. & Broome) Spirin & Malysheva	LE 38182	KX262162	KX262112	Malysheva & Spirin (2017)
Heteroradulum deglubens	LE 225523	KX262163	KX262113	Malysheva & Spirin (2017)
Heteroradulum deglubens	Solheim 1864	KX262181	KX262133	Malysheva & Spirin (2017)
Heteroradulum kmetii (Bres.) Spirin & Malysheva	H lectotype	KX262173	KX262124	Malysheva & Spirin (2017)
Heteroradulum kmetii	DAOM 145605	KX262183	KX262135	Malysheva & Spirin (2017)
Hirneolina hirneoloides (Pat.) Sacc. & Trotter	USJ 55480	AF291334	AF291283	Weiss & Oberwinkler (2001)
Hyalodon piceicola (Kühner ex Bourdot) Malysheva & Spirin	Spirin 2689	MG735422	MG735414	Malysheva el al. (2018)
Hyalodon piceicola	Spirin 6536	MG735421	MG735413	Malysheva el al. (2018)
Metulochaete sanctae-catharinae (Möller) R.L.M. Alvarenga	AMO 678	MK480575	MK484065	Spirin *et al.* (2019b)
Myxarium cinnamomescens (Raitv.) Raitv.	O F160494	KY801909	KY801882	Spirin *et al.* (2018)
Myxarium cinnamomescens	VS 11350	MK098936	MK098888	Spirin *et al.* (2019a)
Myxarium grilletii (Boud.) D.A. Reid	VS9016	MK098944	MK098896	Spirin *et al.* (2019a)
Myxarium hyalinum (Pers.) Donk	TL2012 443455	KY801907	KY801880	Spirin *et al.* (2018)
Myxarium hyalinum	Miettinen 19855	KY801915	–	Spirin *et al.* (2018)
Myxarium legonii (P. Roberts) P. Roberts	VS 8986	MK098947	MK098899	Spirin *et al.* (2019a)
Myxarium legonii	OM 15677	MK098948	MK098901	Spirin *et al.* (2019a)

TABLE 1 . — Continuation

Taxa	Voucher	GenBank accecion numbers nLSU	nITS	References
Proterochaete adusta (Burt) Spirin & Malysheva	VS9021	MK391528	MK391520	Alvarenga *et al.* (2019)
Protodaedalea foliacea (Pat.) Sotome & T. Hatt.	Miettinen 13 054	MG757507	MG757507	Malysheva *et al.* (2018)
Protodaedalea hispida Imazeki	Spirin 5139	MG757510	MG757510	Malysheva *et al.* (2018)
Protodaedalea hispida	WD 548	AB871749	AB871768	Sotome *et al.* (2014)
Protodaedalea hispida	Yuan 5691	JQ764644	JQ764666	Zhou & Dai (2013)
Protodontia africana A. Savchenko & Spirin	AS 171126 1104	MK098973	MK098978	Spirin *et al.* (2019a)
Protodontia insularis Spirin & Malysheva	LR 49417	MK098968	MK098924	Spirin *et al.* (2019a)
Protodontia subgelatinosa (P. Karst.) Pilát	VS 11038	MK098969	MK098926	Spirin *et al.* (2019a)
Protodontia subgelatinosa	Spirin 11079	MG735420	MG735412	Malysheva *et al.* (2018)
Protohydnum cartilagineum Möller	SP467240	MG735426	MG735419	Malysheva *et al.* (2018)
Protomerulius brasiliensis Möller	Ryv 19735	AF291359	–	Spirin *et al.* (2019b)
Protomerulius dubius (Bourdot & Galzin) Spirin & V. Malysheva	VS 3019	MK480553	MK484041	Spirin *et al.* (2019b)
Protomerulius minor (Möller) Spirin & Miettinen	KHL 15937	MK480569	MK484060	Spirin *et al.* (2019b)
Protomerulius substuppeus (Berk. & Cooke) Ryvarden	O 19171	JQ764649	JX134482	Spirin *et al.* (2019b)
Pseudohydnum gelatinosum (Scop.) P. Karst.	F14063	AF384861	AF384861	Weiss & Oberwinkler (2001)
Pseudohydnum gelatinosum	AFTOL ID1875	DQ520094	DQ520094	Lutzoni *et al.* (2004)
Sclerotrema griseobrunneum (K. Wells & Raitv.) Spirin & Malysheva	Niemela 2722	KX262192	KX262144	Malysheva & Spirin (2017)
Sclerotrema griseobrunneum	Spirin 7674	KX262188	KX262140	Malysheva & Spirin (2017)
Sistotrema brinkmannii (Bres.) J. Erikss.	Isolate 236 e	JX535170	JX535169	GenBank
Stypellopsis farlowii (Burt) Spirin & K.H. Larss.	Larsson 12337	MG857099	MG857095	Spirin *et al.* (2018)
Stypellopsis hyperborea Spirin & Malysheva	J Norden 9751	MG857101	MG857097	Spirin *et al.* (2018)
Stypellopsis hyperborea	Spirin 11066	MG857102	MG857096	Spirin *et al.* (2018)
Tremellochaete atlantica Alvarenga	URM90199	MG594383	MG594381	Phookamsak *et al*. (2019)
Tremellochaete atlantica	URM90198	MG594384	MG594382	Phookamsak *et al*. (2019)
Tremellochaete cerradensis Alvarenga	URM90200	MK391530	MK391524	Alvarenga *et al.* (2019)
Tremellochaete japonica (Yasuda) Raitv.	TAA 42689	AF291320	AF291274	Weiss & Oberwinkler (2001)
Tremiscus helvelloides (DC.) Donk	AFTOL ID1680	DQ520100	DQ520100	Lutzoni *et al.* (2004)
Tremiscus helvelloides	TUB 019107	FJ644523	–	Weiss & Oberwinkler (2001)

Crystallodon Alvarenga gen. nov. is represented by the type species *Crystallodon subgelatinosum* (Bodman) Alvarenga & Gibertoni comb. nov.

TAXONOMY

Family Incertae sedis

Crystallodon Alvarenga gen. nov.
(Figs 1, 2)

TYPE SPECIES. — *Heterochaete subgelatinosa* Bodman, *Lloydia* 15 (4): 228 (1953).

MYCOBANK NUMBER. — MB 832484.

ETYMOLOGY. — From '*crystallum*' (Lat., noun.) – crystal, and '*odon*' (Greek, noun) – tooth.

SYSTEMATIC POSITION. — Basidiomycota, Agaricomycetes, Auriculariales, *Incertae Sedis.*

DIAGNOSIS. — Basidiomata annual, resupinate, effused, closely adnate, gelatinous to crustaceous. Margin adnate, fimbriate. Hymenial surface covered by sharp-pointed sterile spines (hyphal pegs) formed by a thin core made of hyphae (hyphal core) enclosed by abundant crystals. Hyphal structure monomitic, hyphae clamped. Cystidia fusiform, cylindrical, often sinuous, some with refractive content. Hyphidia in hymenium, hyaline, thin-walled. Fertile hyphae, tortuous, forming 2-4 basidia at the apex, collapsed basidia often present. Basidia ellipsoid-ovoid, 4-celled, basidiospores cylindrical to broadly cylindrical, slightly curved, with oil droplets in the cytoplasm. Phylogenetically, the genus represents a new lineage in Auriculariales.

NOTES
Recently, Brazilian specimens displaying hyphal pegs were proposed to be attributed to two new genera, *Adustochaete* and *Metulochaete* (Alvarenga *et al.* 2019; Spirin *et al.* 2019b). In *Adustochaete*, hyphal pegs are formed by smooth tramal hyphae and encrusted dendrohyphidia, while in *Metulochaete* hyphal pegs are formed by densely glued hyphae with strongly encrusted apical parts similar to metuloid cystidia. Therefore, so far, *Crystallodon* Alvarenga gen. nov. is the only genus among resupinate Auriculariales that has been reported to display hyphal pegs formed by a thin core of hyphae covered by angular crystals.

Crystallodon subgelatinosum (Bodman) Alvarenga & Gibertoni comb. nov.
(Figs 1, 2)

Heterochaete subgelatinosa Bodman, *Lloydia* 15 (4): 228 (1953).

MYCOBANK NUMBER. — MB 832485.

HOLOTYPE. — Panama. Chiriquí, Casita Alta, above Boquete, 23.VIII.1937, G.W. Martin 4424 [NY(NY00738348)].

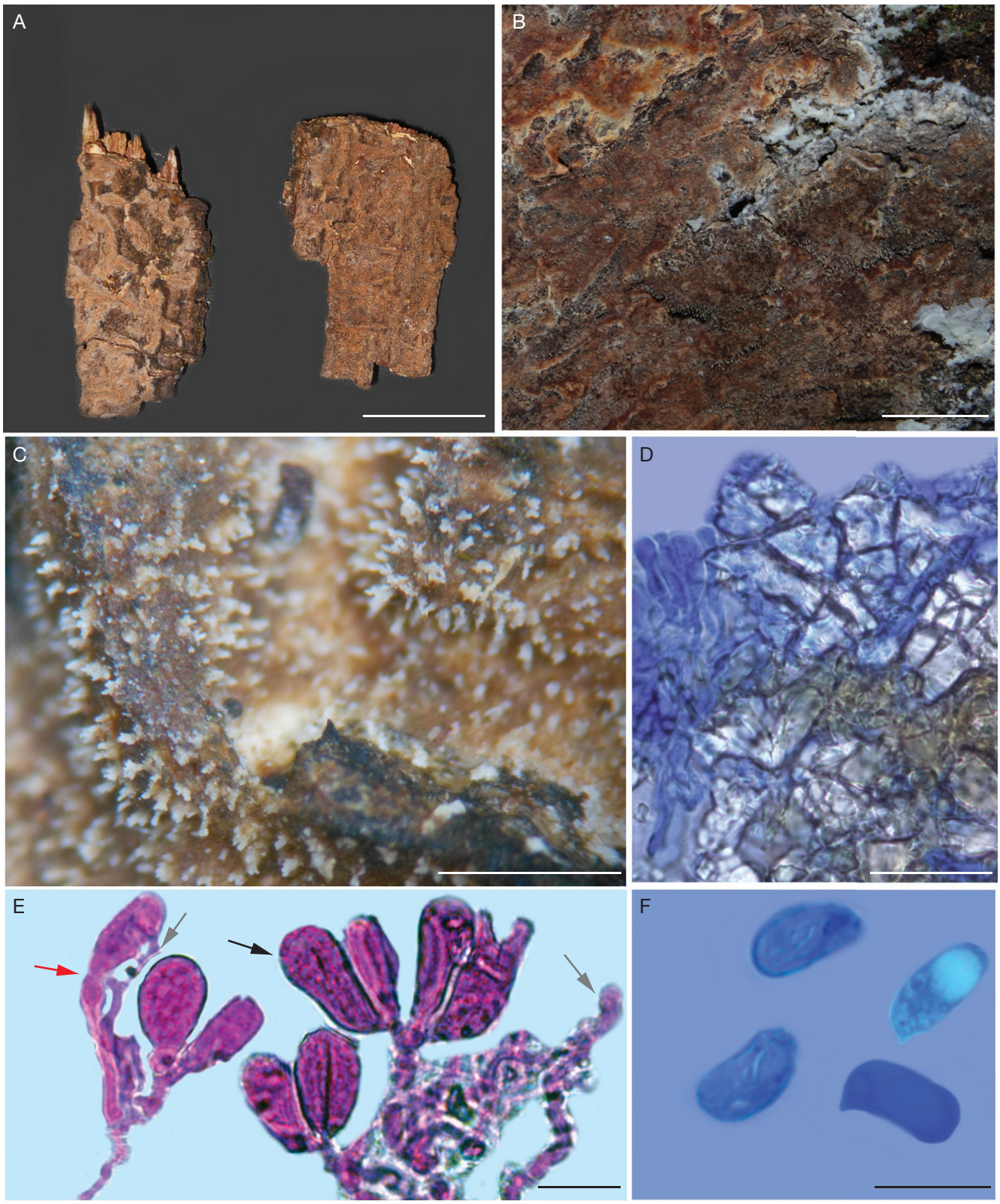

Fig. 2. — *Crystallodon subgelatinosum* (Bodman) Alvarenga & Gibertoni, comb. nov. (URM 93444): **A**, basidiomata; **B**, fresh hymenophore (URM 93443); **C**, dry hymenophore (URM 93444); **D**, crystal agglomeration; **E**, basidia (**black arrow**), cystidia (**red arrow**), hyphidia (**grey arrows**); **F**, basidiospores. Scale bars: A, 2 cm; B, 1 cm; C, 10 mm; D, 50 µm; E, F, 10 µm.

SYSTEMATIC POSITION. — Basidiomycota, Agaricomycetes, Auriculariales, *Incertae Sedis, Crystallodon.*

SPECIMENS EXAMINED. — **Brazil**. Pernambuco, Olinda, Sétimo Grupo de Artilharia de Campanha (7° GAC), 16.VI.2018, Gibertoni, TB (TBG 4b, TBG BF-18001 – URM 93445); Chikowski, R.S. (RC1609 – URM 93444); Tamandaré, Reserva Biológica de Saltinho, 25.VI.2018, Xavier-Lima, V (VXLF166 – URM 93443).

DESCRIPTION

Basidiomata

Annual, resupinate, effused, closely adnate, later fusing with adjoining basidiomata, gelatinous when fresh, crustaceous when dried. Margin adnate, fimbriate, paler than hymenial surface (5C4). Hymenial surface gelatinized when fresh, light brown (5D5), densely covered by sharp-pointed sterile spines formed by hyphae enveloped by often apically branched crystals, spines 75-355 × 35-40 µm [50-80 µm, notes by Viacheslav Spirin about the type specimen (pers. com.)], 5-6 per mm. Hyphal structure monomitic, hyphae clamped.

Subiculum

Not clearly differentiable, subhymenium with hyphae hyaline, thin-walled, 1-2.5 µm, clamped.

Cystidia

Fusiform, cylindrical to often sinuous, 45-50 × 4-7 µm, some with refractive content.

Hyphidia

Abundant in hymenium, hyaline, thin-walled, 0.5-1 µm at apex.

Fertile hyphae

1-3 µm, tortuous, forming 2-4 basidia at the apex.

Basidia

Ellipsoid-ovoid, 4-celled, 10.7-18.6 × 4.8-8.2 µm [15-20 × 10-12 µm in the original description by Bodman (1952); (14.2-)15-19.8 (-22) × (8-) 8.5-14.2(-16) µm by V. Spirin (pers. com.)].

Basidiospores

Cylindrical to broadly cylindrical, slightly curved, (8-) 8.0-11.7 (-12) × (3.7-) 4-6.1 (-6.6) µm (n = 24/1), L =10.4, W = 5.21, Q' = (2.4-) 1.64-2.65, Q =2.26, with oil droplets in the cytoplasm [(9-)10-13(-15) × (4.5-)5-6(-7.5) µm in the original description by Bodman (1952); 10-13.9 × 5-6 µm by V. Spirin (pers. com.)].

NOTES

Crystallodon subgelatinosum comb. nov. can be easily recognized by the hyphal pegs, formed by few subicular hyphae densely covered with angular crystals, and by the dark brown hymenophore. The presence of hyphal pegs covered by crystals may occur in different genera of Auriculariales (e.g. *Adustochaete*, *Eichleriella*) (Malysheva & Spirin 2017; Alvarenga *et al.* 2019); however, such hyphal pegs are commonly formed by thick-walled hyphae from the subiculum, and thus are different from those of *Crystallodon* Alvarenga gen. nov.

Crystallodon subgelatinosum comb. nov. was first described by Bodman (1952) as *Heterochaete subgelatinosa*, based on specimens from Panama, this being the only record of the species until now. Basidia and basidiospores from the Brazilian collections are slightly smaller than those from the original description (Bodman 1952) and the notes provided by V. Spirin (pers. com.), and spines are narrower than those observed by V. Spirin (pers. com.); therefore, these collections may represent a different species. However, we prefer to consider these differences as due to intraspecific variation until additional material has been collected from the type locality, and morphologically and genetically analyses for a better distinction and delimitation of the taxon.

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REFERENCES

ALVARENGA R. L. M., SPIRIN V., MALYSHEVA V., GIBERTONI T. B. & LARSSON K. H. 2019. — Two new genera and six other novelties in *Heterochaete sensu lato* (Auriculariales, Basidiomycota). *Botany* 97 (8): 439-451. https://doi.org/10.1139/cjb-2019-0046

BODMAN M. C. 1952. — A taxonomic study of the genus *Heterochaete*. *Lloydia* 15: 193-233.

GARDES M. & BRUNS T. D. 1993. — ITS primers with enhanced specificity for Basidiomycetes: application to identification of mycorrhizae and rusts. *Molecular Ecology* 2: 113-118. https://doi.org/10.1111/j.1365-294X.1993.tb00005.x

GUINDON S. & GASCUEL O. 2003. — A simple, fast, and accurate algorithm to estimate large phylogenies by maximum likelihood. *Systematic Biology* 52: 696-704. https://doi.org/10.1080/10635150390235520

HIBBETT D. S., BAUER R., BINDER M., GIACHINI A. J., HOSAKA K., JUSTO A., LARSSON E., LARSSON K. H., LAWREY J. D., MIETTINEN O., NAGY L., NILSSON R. H., WEISS M. & THORN R. G. 2014. — 14 Agaricomycetes, *in* MCLAUGHLIN D. & SPATAFORA J. (eds), *Systematics and Evolution. The Mycota* (A Comprehensive Treatise on Fungi as Experimental Systems for Basic and Applied Research), vol 7A. Springer, Berlin, Heidelberg, 373-430

KATOH K. & TOH H. 2008. — Recent developments in the MAFFT multiple sequence alignment program. *Briefings in Bioinformatics* 9: 286-298. https://doi.org/10.1093/bib/bbn013

KORNERUP A. & WANSCHER J. H. 1978. — Methuen handbook of colour, 3rd ed. Eyre Methuen Ltd., London, 252 p.

Lowy B. 1971. — Tremellales. *Flora neotropica* 6:1-153
Lowy B. 1976. — New Tremellales from Panama. *Mycologia* 68: 1103-1108. https://doi.org/10.1080/00275514.1976.12019993
Lowy B. 1977. — A new *Heterochaete*. *Mycotaxon* 5 (2): 449-452. https://doi.org/10.3758/BF03197384
Lowy B. 1987. — New Brazilian Heterobasidiomycetes. *Mycotaxon* 29: 11-19.
Lutzoni F., Kauff F., Cox C. J., Mclaughlin D., Celio G., Dentinger B., Padamsee M., Hibbett D., James T. Y., Baloch E., Grube M., Reeb V., Hofstetter V., Schoch C., Arnold E. A., Miadlikowska J., Spatafora J., Johnson D., Hambleton S., Crockett M., Shoemaker R., Sung G.-H., Lücking R., Lumbsch T., O'Donnell K., Binder M., Diederich P., Ertz D., Gueidan C., Hansen K., Harris R. C., Hosaka K., Lim Y.-W., Matheny B., Nishida H., Pfister D., Rogers J., Rossman A., Schmitt I., Sipman H., Stone J., Sugiyama J., Yahr R. & Vilgalys R. 2004. — Assembling the fungal tree of life:progress, classification, and evolution of subcellular traits. *American Journal of Botany* 91: 1446-1480. https://doi.org/10.3732/ajb.91.10.1446
Malysheva V. & Spirin V. 2017. — Taxonomy and phylogeny of the Auriculariales (Agaricomycetes, Basidiomycota) with stereoid basidiocarps. *Fungal Biology* 121: 689-715. https://doi.org/10.1016/j.funbio.2017.05.001
Malysheva V., Spirin V., Miettinen O., Motato-Vásquez V., Hernawati J. S. S. & Larsson K. H. 2018. — Revision of *Protohydnum* (Auriculariales, Basidiomycota). *Mycological Progress* 17 (7): 805-814. https://doi.org/10.1007/s11557-018-1393-6
Miettinen O., Spirin V. & Niemela T. 2012. — Notes on the genus *Aporpium* (Auriculariales, Basidiomycota), with a new species from temperate Europe. *Annales Botanici Fennici* 49: 359-368. https://doi.org/10.5735/085.049.0607
Phookamsak R., Hyde K. D., Jeewon R., Bhat J. D., Jones G. E. B., Maharachchikumbura S. S. N., Raspé O., Karunarathna S. C., WanasingheD. N. , Hongsanan S., Doilom M., Tennakoon D. S., Machado A. R., Firmino A. L., Ghosh A., Karunarathna A., Mešić A., Dutta A. K., Thongbai B., Devadatha B., Norphanphoun C., Senwanna C., Wei D., Pem D., Ackah F. K., Wang G.-N., Jiang H.-B., Madrid H., Lee H. B., Goonasekara I. D., Manawasinghe I. S., Kušan I., Cano J., Gené J., Li J., Das K., Acharya K., Raj A. K. N., Latha D., ChethanaT. K. W., He M.-Q., Dueñas M., Jadan M., Martín M. P., Samarakoon M. C., Dayarathne M. C., Raza M., Park M. S., Telleria T. M., Chaiwan N., Matočec N., de Silva N. I., Pereira O. L., Singh P. N., Manimohan P., Uniyal P., Shang Q.-J., Bhatt R. P., Perera R. H., Alvarenga R. L. M., Nogal-Prata S., Singh S. K., Vadthanarat S., Oh S.-Y., Huang S.-K., Rana S., Konta S., Paloi S., Jayasiri S. C., Jeon S. J., Mehmood T., Gibertoni T. B., Nguyen T. T., Singh U., Thiyagaraja V., Sarma V. V., Dong W., Yu X.-D., Lu Y.-Z., Lim Y. W., Chen Y., Tkalčec Z., Zhang Z.-F., Luo Z.-L., Daranagama D. A., Thambugala K. M., Tibpromma S., Camporesi E., Bulgakov T. S., Dissanayake A. J., Senanayake I. C., Dai D. Q., Tang L.-Z., Khan S., Zhang H., Promputtha I., Cai L., Chomnunti P., Zhao R.-L., Lumyong S., Boonmee S., Wen T.-C., Mortimer P. E. & Xu J. 2019. — Fungal diversity notes 929-1035: taxonomic and phylogenetic contributions on genera and species of fungi. *Fungal Diversity*: 1-273. https://doi.org/10.1007/s13225-019-00421-w
Roberts P. 2003. — Heterobasidiomycetes from Rancho Grande, Venezuela. *Mycotaxon* 86: 25-41.
Roberts P. 2006. — Caribbean heterobasidiomycetes: 2. Jamaica. *Mycotaxon* 96: 83-107.
Roberts P. 2008. — Caribbean heterobasidiomycetes: 3. British Virgin Islands. *Mycotaxon* 105: 137-147.
Ronquist F. & Huelsenbeck J. P. 2003. — MRBAYE S 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* 19: 1572-1574. https://doi.org/10.1093/bioinformatics/btg180
Sotome K., Maekawa N., Nakagiri A., Lee S. S. & Hattori H. 2014. — Taxonomic study of Asian species of poroid Auriculariales. *Mycological Progress* 13: 987-997. https://doi.org/10.1007/s11557-014-0984-0
Spirin V., Malysheva V. & Larsson K. H. 2018. — On some forgotten species of *Exidia* and *Myxarium* (Auriculariales, Basidiomycota). *Nordic Journal of Botany* 2018: e01601. https://doi.org/10.1111/njb.01601
Spirin V., Malysheva V., Roberts P., Trichies G., Savchenko A. & Larsson K. H. 2019a. — A convolute diversity of the Auriculariales (Agaricomycetes, Basidiomycota) with sphaeropedunculate basidia. *Nordic Journal of Botany* 2019: e02394.
Spirin V., Malysheva V., Miettinen O., Vlasák,J. Alvarenga R. L. M., Gibertoni, T. B., Ryvarden L. & Larsson K. H. 2019b. — On Protomerulius and Heterochaetella (Auriculariales, Basidiomycota). *Mycological Progress* 18: 1079-1099. https://doi.org/10.1007/s11557-019-01507-0
Staden R., Beal K. F. & Bonfield J. K. 1998. — The Staden Package. Computer Methods in Molecular Biology 132, *in* Misener S. & Krawetz S. A. (eds) *Bioinformatics Methods and Protocols*. The Humana Press: 115-130. https://doi.org/10.1385/1-59259-192-2:115
Tamura K., Stecher G., Peterson D., Filipski A. & Kumar S. 2013. — MEGA6: molecular evolutionary genetics analysis version 6.0. *Molecular Biology and Evolution* 30: 2725-2729. https://doi.org/10.1093/molbev/mst197
Thiers B. 2016. — Index Herbariorum: a global directory of public herbaria and associated stuff [continuously updated]. Botanical Garden's Virtual Herbarium, New York. http://sweetgum.nybg.org/ih [Accessed 2 August 2019].
Viégas A. P. 1945. — Alguns fungos do Brasil. VI. Dacryomycetaceae e Tremellaceae. *Bragantia* 5: 239-251. https://doi.org/10.1590/S0006-87051945000400002
Vilgalys R. & Hester M. 1990. — Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. *Journal of Bacteriology* 172: 4238-4246. https://doi.org/10.1128/jb.172.8.4238-4246.1990
Weiss M. & Oberwinkler F. 2001. — Phylogenetic relationships in Auriculariales and related groups and hypotheses derived from nuclear ribosomal DNA sequences. *Mycological Research* 105: 403-415. https://doi.org/10.1017/S095375620100363X
Wells K. & Bandoni R. J. 2001. — Heterobasidiomycetes, *in* Mc Laughlin D. J., Mc Laughlin E. G. & Lemke P. A., (eds), *The Mycota. (A Comprehensive Treatise on Fungi as Experimental Systems for Basic and Applied Research)*, vol 7B. Springer, Berlin, Heidelberg: 85-120.
White T. J., Bruns T., Lee S. & Taylor J. 1990. — Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. *PCR protocols: a Guide to Methods and Applications* 18: 315-322. https://doi.org/10.1016/B978-0-12-372180-8.50042-1
Wu F., Yuan Y. & Dai Y. C. 2015. — Phylogeny and diversity of the Auricularia mesenterica (Auriculariales, Basidiomycota) complex. *Mycol Progress* 14: 42. https://doi.org/10.1007/s11557-015-1065-8
Zhou L. W. & Dai Y. C. 2013. —Phylogeny and taxonomy of poroid and lamellate genera in the Auriculariales (Basidiomycota). *Mycologia* 105: 1219-1230. https://doi.org/10.3852/12-212

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