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A new taxonomic classification for species in *Gomphus* sensu lato

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Abstract – Taxonomy of the *Gomphales* has been revisited by combining morphology and molecular data (DNA sequences) to provide a natural classification for the species of *Gomphus* sensu lato. Results indicate *Gomphus* s.l. to be non-monophyletic, leading to new combinations and the placement of its species into four genera: *Gomphus* sensu stricto (3 species), *Gloeocantharellus* (11 species), *Phaeoclavulina* (41 species), and *Turbinellus* (5 species).

Key words – Fries, nomenclature, Persoon, systematics

Introduction

Gomphus sensu lato (*Gomphaceae*, *Gomphales*, *Basidiomycota*) is characterized by fleshy basidiomata that can have funnel- or fan-shaped pilei with wrinkled, decurrent hymenia. The genus, which was described by Persoon (1797a), has undergone several taxonomic and nomenclatural modifications over the past 200 years.

The taxonomy of *Gomphus* s.l. (*Gomphales*) has proven difficult because of the few reliable morphological characters available for classification. Consequently, species of *Gomphus* s.l. have been classified under *Cantharellus, Chloroneuron, Chlorophyllum, Craterellus, Gloeocantharellus, Nevrophyllum*, and *Turbinellus*.

A few species are mycorrhizal (Agerer et al. 1998, Bulakh 1978, Guzmán & Villarreal 1985, Khokhryakov 1956, Kropp & Trappe 1982, Masui 1926, 1927, Pantidou 1980, Trappe 1960, Valdés-Ramirez 1972). Some are considered rare

and endangered, especially in the Pacific Northwestern USA (USDA/USDI 1994) and certain regions of Europe (Bulakh 1978, Bulakh & Govorova 2000, Dahlberg & Croneborg 2003, Kluzák 1994, Urbonas et al. 1990). *Gomphus bonarii, G. clavatus, G. floccosus*, and *G. kauffmanii* are listed as threatened in the 1994 Northwest Forest Plan (USDA/USDI 1994) because of their apparent close association with old-growth forests. *Gomphus clavatus* is considered rare (red-listed) in 17 countries of Europe (Dahlberg & Croneborg 2003).

Nomenclatural history of *Gomphus* sensu lato

The concept of *Gomphus* s.l. was established when Persoon (1796) first mentioned the name *Merulius*. Subsequently Persoon (1797b) proposed four new combinations, including *M. violaceus* (= *M. clavatus*). Persoon (1797a) also introduced the name *Gomphus* at the generic level, but did not assign species to his newly created genus; still the name was validly published. Later Persoon (1801) transferred *Gomphus* to *Merulius* section *Gomphus* with two documented taxa [*M. clavatus* var. *violaceus* and *M. clavatus* var. *spadiceus* (= *Clavaria truncata* Schmidel)] and afterward restored the genus rank to *Gomphus* (Persoon 1825) with five species, including *G. truncatus* (= *M. clavatus*). Gray (1821) accepted Persoon's genus name, which he assigned to one species, *Gomphus clavatus*. The genus has frequently been cited in the past as "*Gomphus* (Pers.) Gray" or "*Gomphus* Pers. ex Gray"; but once the starting date for fungal nomenclature was emended to 1753 (Voss et al. 1983), the correct citation has been *Gomphus* Pers.

Fries (1821) accepted *Gomphus* only at the infrageneric level, as *Cantharellus* 'tribus' *Gomphus* (not to be confused with the unrelated *Agaricus* subgen. *Gomphus* Fr.) and subsequently (Fries 1825) introduced the genus *Gomphora* as a nomenclatural synonym of *Gomphus* Pers.

Other authors involved with shaping the history of *Gomphus* s.l. included Schweinitz (1832), Berkeley (1839), Berkeley & Curtis (1859), Peck (1887), and Smith & Morse (1947), all of whom assigned gomphoid species to *Cantharellus*. Fries (1838) moved *Merulius clavatus* to *Craterellus*. Doassans & Patouillard (1886) described *Nevrophyllum* to accommodate *Gomphus* species, and Earle (1909) proposed *Turbinellus* to accommodate some species formerly assigned to *Cantharellus*.

Singer (1945) described *Gloeocantharellus* (based on *Cantharellus purpurascens*) with the key diagnostic character of gloeocystidia to separate it from *Cantharellus*. More importantly, here he also recognized *Gomphus* at the generic level, recombining *Cantharellus bonarii* as *G. bonarii*.

Corner (1950, 1966, 1970), and Petersen (1967, 1968, 1969, 1971, 1972), who clarified the natural classification of this group, accepted the classifications proposed by Donk (1933, 1941, 1949a,b), who also proposed the family

Gomphaceae (Donk 1961). The *Gomphaceae* was considered a member of the *Aphyllophorales* until Jülich (1981) proposed the order *Gomphales*.

The molecular overview of gomphoid-phalloid phylogeny by Hosaka et al. (2006) incorporated the data from Giachini (2004) for *Gomphus* s.l., including its four generic segregates. We here provide the conclusions from Giachini's research, a key to the segregate genera, and a list of accepted names, including new combinations, and synonyms.

Systematics, taxonomy, and evolutionary biology

Most difficulties in identifying taxa of *Gomphus* s.l. arise because of the few reliable morphological characters available for classification. However, distinctive clusters of species can be consistently separated by morphology. Most are united by a few consistent features, such as fan-shaped, lilaceous vs. funnel-shaped, orange-brown pilei, scaly vs. inconspicuously fibrous pileus surface, presence vs. absence of clamp connections, echinulate vs. verrucose spores, tropical vs. temperate habitat, etc.

Given the difficulty in identifying species of *Gomphus* s.l. by morphological characters, combined morphological and molecular data (DNA sequences) were used to verify the monophyly of *Gomphus* and to identify morphological features to reliably separate taxa within *Gomphus*.

Materials & methods

Collections examined

In all, 434 collections of *Gomphales* species were analyzed for distinct macro- and micro-morphological features, of which 189 were selected for molecular characterization (for details see Giachini 2004, Giachini et al. 2010).

Molecular characterization

Twenty-nine sequences of *Gomphus* s.l. representing 22 taxa were sampled for molecular characterization and phylogenetic analysis; DNA extraction, purification, sequencing, and analyses are according to Giachini (2004) and Giachini et al. (2010).

Results

Reexamination of generic types by morphological and molecular approaches revealed the inadequacy of some characters used by early workers to differentiate species within *Gomphus* s.l. Additionally, genetic data strongly suggest that *Gomphus* s.l. is not monophyletic (Giachini 2004, Giachini et al. 2010). Rather, it originated several times within the order *Gomphales* (Giachini et al. 2010: figures 1, 2). Because basidioma morphology and overall microscopic characteristics differentiate among species in many clades within *Gomphus* s.l., segregation of species into the genera *Gomphus* s.s., *Gloeocantharellus*, *Phaeoclavulina* (some species of *Gomphus* s.l. and all species of *Ramaria* subgenus *Echinoramaria*),

and *Turbinellus* is proposed. Detailed description of all species listed here will be published elsewhere.

Key to genera

1a. Basidiomata unipileate or merismatoid (composed of several pilei); pileus mostly funnel-shaped, surface almost glabrous to fibrillose, appressed-floccose, squamose scaly or with heavy recurved scales; clamp connections sometimes present but mostly absent; spores verrucose. **2**

1b. Basidiomata ramarioid, unipileate or merismatoid; pileus, when present, fan- to funnel-shaped, surface glabrous; clamp connections always present; spores echinulate, verrucose, subreticulate or reticulate **3**

2a. Pileus minutely to strongly scaly, orange-yellow to orange-scarlet, blood red, pale orange, orange, or brown, often changing color on drying; scales generally darker than pileus surface; hymenium wrinkled . . . . . ***Turbinellus***

2b. Pileus glabrous to tomentose, off-white, pale yellow, pale yellow brown, yellow-pink, pale to livid orange, orange-pink, pink, pale brown, dark yellow-orange, dark rusty brown, or pale red; hymenium decurrent, supported by either true lamellae, bifurcating broad hymenial folds, or wrinkled folds. . . . . ***Gloeocantharellus***

3a. Basidiomata unipileate or merismatoid, terrestrial; pileus fan-shaped to slightly funnel-shaped, bright violet, pale olivaceous or brown; hymenium wrinkled to almost poroid, violet, vinaceous brown to milky-coffee colored; spores verrucose . . . . . ***Gomphus***

3b. Basidiomata ramarioid, unipileate or merismatoid, sometimes lignicolous; pileus, when present, funnel-shaped or fan-shaped, pileus and branch surfaces white, brown-green, pale to sordid olivaceous, violet, brown-yellow or red-cinnamon, gray, brick red, or pale to dark orange-yellow; hymenium smooth in some species, sublamellate or irregularly wrinkled with decurrent folds in others, in general yellow to orange-red or brown, pale to sordid olivaceous, or violet; spores echinulate (mostly with acute spines), verrucose, subreticulate or reticulate . . . . . ***Phaeoclavulina***

Accepted names and new combinations

New synonymies are prefixed with an asterisk * (based on Giachini et al. 2010)

Gomphus Pers. Tent. Disp. Meth. Fung.: 74 (1797)

[non *Gomphus* (Fr.) Weinm. 1826].

≡ *Merulius* sect. *Gomphus* Pers., Syn. Meth. Fung.: 498 (1801).

≡ *Cantharellus* 'trib.' *Gomphus* (Pers.) Fr., Syst. Mycol. 1: 322 (1821).

≡ *Gomphora* Fr., Syst. Orb. Veg.: 88 (1825).

≡ *Nevrophyllum* Pat., in Doassans & Patouillard, Revue Mycol. 8: 26 (1886), nom. illegit. [non *Neurophyllum* Torr. & A. Gray 1840].

≡ *Cantharellus* sect. *Gomphus* A.H. Sm. & Morse, Mycologia 39: 499 (1947).

Type species: *Gomphus clavatus* (Pers.) Gray 1821.

Gomphus brunneus (Heinem.) Corner, Ann. Bot. Mem. 2: 116 (1966).

Basionym: *Neurophyllum brunneum* Heinem., Bull. Jard. Bot. Etat. Brux. 28: 435 (1958).

= *Gomphus clavatus* var. *parvisporus* Corner, Ann. Bot. Mem. 2: 118 (1966).

Gomphus clavatus (Pers.) Gray, Nat. Arr. Brit. Pl. 1: 638 (1821).

Basionym: *Merulius clavatus* Pers., Observ. Mycol. 1: 21 (1796).

≡ *Cantharellus clavatus* (Pers.) Fr., Syst. Mycol. 1: 322 (1821).

≡ *Craterellus clavatus* (Pers.) Fr., Epicr. Syst. Mycol.: 533 (1838).

≡ *Thelephora clavata* (Pers.) P. Kumm., Führ. Pilzk.: 46 (1871).

≡ *Nevrophyllum clavatum* (Pers.) Pat., in Doassans & Patouillard, Revue Mycol. 8: 26 (1886).

≡ *Trombetta clavata* (Pers.) Kuntze, Revis. Gen. Pl. 2: 873 (1891).

= *Clavaria elveloides* Wulfen, Miscell. Austriaca Bot. 2: 99 (1781).

= *Clavaria truncata* Schmidel , Anal. Pl. 3: 237 (1796).

≡ *Gomphus truncatus* (Schmidel) Pers., Mycol. Eur. 2: 9 (1825).

= *Merulius clavatus* var. *spadiceus* Pers., Syn. Meth. Fung.: 498 (1801).

= *Cantharellus brevipes* Peck, Rep. N. Y. St. Mus. Nat. Hist. 33: 21 (1883).

≡ *Merulius brevipes* (Peck) Kuntze, Revis. Gen. Pl. 2: 862 (1891).

= *Craterellus nucleatus* Schröd., Centralbl. Gesammte Forstwes. 34: 396 (1908).

*= *Cantharellus purpuraceus* Iwade, Bull. Tokyo Univ. Forests. 33: 54 (1944).

≡ *Gomphus purpuraceus* (Iwade) K. Yokoy., in Imazeki, Colour. Illustr. Mushr. Japan 2: 98 (1989).

Gomphus crassipes (L.M. Dufour) Maire, in Maire & Werner, Mém. Soc. Sci. Nat. Maroc 45: 81 (1937).

Basionym: *Cantharellus crassipes* L.M. Dufour, Rev. Gen. Bot. 1: 358 (1889).

≡ *Merulius crassipes* (L.M. Dufour) Kuntze, Revis. Gen. Pl. 3(2): 494 (1898).

≡ *Nevrophyllum crassipes* (L.M. Dufour) Maire, Bull. Soc. Mycol. Fr. 30: 214 (1914).

Gloeocantharellus Singer, Lloydia 8: 140 (1945).

= *Linderomyces* Singer, Farlowia 3: 157 (1947).

Type species: *Cantharellus purpurascens* Hesler 1944.

Gloeocantharellus corneri (Singer) Corner, Nova Hedwigia 18: 799 (1970).

Basionym: *Linderomyces corneri* Singer, Vellozia 1: 14 (1961).

Gloeocantharellus dingleyae (Segedin) Giachini, **comb. nov.**

MycoBank MB512928

Basionym: *Gomphus dingleyae* Segedin, New Zealand J. Bot. 22: 536 (1985), as "*dingleyi*".

Note: The masculine termination '*-i*' is an error to be corrected to '*-ae*', because the epithet is a feminine possessive noun honouring Joan Dingley [see McNeill et al. 2006: Art. 32.7, 60.11 + Rec. 60C.1(a)].

Gloeocantharellus echinosporus Corner, Nova Hedwigia 18: 801 (1970).

Gloeocantharellus lateritius (Petch) Corner, Nova Hedwigia 18: 803 (1970).

Basionym: *Paxillus lateritius* Petch, Ann. Roy. Bot. Gard. Peradeniya 6: 202 (1917).

≡ *Phyllobolites lateritius* (Petch) Singer, Ann. Mycol. 40: 59 (1942).
≡ *Linderomyces lateritius* (Petch) Singer, Farlowia 3: 157 (1947).
≡ *Gomphus lateritius* (Petch) R.H. Petersen, J. Elisha Mitchell Scient. Soc. 84: 380 (1968).

Gloeocantharellus mamorensis (Singer) Giachini, **comb. nov.**
MycoBank MB 512929
Basionym: *Gomphus mamorensis* Singer, in Singer et al., Beih. Nova Hedwigia 77: 17 (1983).

Gloeocantharellus novae-zelandiae (Segedin) Giachini, **comb. nov.**
MycoBank MB512930
Basionym: *Gomphus novae-zelandiae* Segedin, New Zealand J. Bot. 22: 533 (1985).

Gloeocantharellus okapaensis (Corner) Corner, Nova Hedwigia 18: 803 (1970).
Basionym: *Gomphus okapaensis* Corner, Ann. Bot. Mem. 2: 123 (1966).

Gloeocantharellus pallidus (Yasuda) Giachini, **comb. nov.**
MycoBank MB512931
Basionym: *Cantharellus pallidus* Yasuda, in Lloyd, Mycol. Notes 47: 661 (1917).
≡ *Gomphus pallidus* (Yasuda) Corner, Ann. Bot. Mem. 2: 123 (1966).

Gloeocantharellus persicinus T.H. Li, Chun Y. Deng & L.M. Wu, in Deng & Li, Mycotaxon 106: 450 (2009).

Gloeocantharellus purpurascens (Hesler) Singer, Lloydia 8: 140 (1945).
Basionym: *Cantharellus purpurascens* Hesler, in Smith & Hesler, Lloydia 6: 248 (1944).
≡ *Gomphus purpurascens* (Hesler) R.H. Petersen, J. Elisha Mitchell Scient. Soc. 84: 380 (1968).

Gloeocantharellus uitotanus Vasco-Pal. & Franco-Mol., Mycotaxon 91: 90 (2005).

Phaeoclavulina Brinkmann, Jahresber. Westfäl. Provinz.-Ver. Wiss. Kunst 25: 197 (1897).
≡ *Clavaria* sect. *Phaeoclavulina* (Brinkmann) Killerm., in Engler & Prantl, Nat. Pflanzenfam. 6: 155 (1928).
*= *Lachnocladium* sect. *Dendrocladium* Pat., J. Bot. Morot 3: 33 (1889).
≡ *Dendrocladium* (Pat.) Lloyd, Mycol. Notes 60: 870 (1919).
≡ *Ramaria* sect. *Dendrocladium* (Pat.) R.H. Petersen, Bibl. Mycol. 79: 44 (1981).
*= *Chloroneuron* Murrill, Mycologia 3: 25 (1911).
≡ *Chlorophyllum* Murrill, North Amer. Flora 9: 172 (1910), nom. illeg. [non *Chlorophyllum* Massee 1898].
≡ *Neurophyllum* subgen. *Chloroneuron* (Murrill) R. Heim, Revue Mycol. 19: 51 (1954).
*= *Clavaria* subsect. *Terrestres* Killerm., in Engler & Prantl, Nat. Pflanzenfam. 6: 154 (1928).
*= *Ramaria* subgen. *Echinoramaria* Corner, Beih. Nova Hedwigia 33: 238 (1970).
*= *Ramaria* ser. *Grandisporae* Corner, Beih. Nova Hedwigia 33: 239 (1970).
≡ *Ramaria* sect. *Grandisporae* (Corner) Franchi & M. Marchetti, Fungi non Delineati 16: 15 (2001).
*= *Ramaria* ser. *Flaccidae* Corner, Beih. Nova Hedwigia 33: 239 (1970).
≡ *Ramaria* sect. *Flaccidae* (Corner) R.H. Petersen, Bibl. Mycol. 79: 100 (1981).

*= *Ramaria* ser. *Virescentes* Corner, Beih. Nova Hedwigia 33: 239 (1970).

*= *Gomphus* subgen. *Phaeoclavulinoides* R.H. Petersen, Mycologia 68: 432 (1976).

Type species: *Phaeoclavulina macrospora* Brinkmann 1897.

Phaeoclavulina abietina (Pers.) Giachini, **comb. nov.**

MycoBank MB512962

Basionym: *Clavaria abietina* Pers., Neues Mag. Bot. 1: 117 (1794) [sanctioned name; non "*Clavaria abietina*" sensu Fr. 1821].

≡ *Merisma abietinum* (Pers.) Spreng., Syst. Veg. 4: 495 (1827).

≡ *Hydnum abietinum* (Pers.) Duby, Bot. Gall 2: 778 (1830).

≡ *Clavariella abietina* (Pers.) P. Karst., Revue Mycol. 3(9): 21 (1880).

≡ *Ramaria abietina* (Pers.) Quél., Fl. Mycol. France: 467 (1888).

= *Clavaria ochraceovirens* Jungh., Linnaea 5: 407 (1830).

≡ *Ramaria ochraceovirens* (Jungh.) Donk var. *ochraceovirens*, Meded. Ned. Mycol. Ver. 22: 112 (1933).

= *Clavaria abietina* f. *persoonii* Fr., Hymenomyc. Eur.: 671 (1874).

= *Clavaria abietina* var. *virens* Gillet, Tab. Anal.: 183 (1884).

*= *Clavaria abietina* subsp. *cyanescens* Romell, in Krok & Almquist, Sv. Fl. Skol., Krypt., 2nd ed., (1911) [not seen; fide Corner 1950].

≡ *Clavaria cyanescens* (Romell) S. Lundell, in Krok & Almquist, Sv. Fl. Skol., Krypt., 5th ed.: 286 (1932) [not seen; fide Corner 1950].

= *Clavaria virescens* Gramberg, Pilz- Kräuterfreund 5: 57 (1921).

≡ *Ramaria virescens* (Gramberg) Hennig, in Michael, Führ. Pilzfr. 3: 320 (1927).

*= *Ramaria ochrochlora* Furrer-Ziogas & Schild, in Schild, Fung. Rar. Icon. Color. 5: 17 (1971).

*= *Ramaria ochraceovirens* var. *parvispora* K.S. Thind, Khurana & S.C. Kaushal, Kavaka 11: 33 (1984).

Phaeoclavulina africana (R.H. Petersen) Giachini, **comb. nov.**

MycoBank MB512932

Basionym: *Gomphus africanus* R.H. Petersen, Mycologia 68: 429 (1976).

Phaeoclavulina angustata (Lév.) Giachini, **comb. nov.**

MycoBank MB512933

Basionym: *Merisma angustatum* Lév., Ann. Sci. Nat., Bot. sér. 3, 5: 158 (1846).

≡ *Thelephora angustata* (Lév.) Fr., Nova Acta Regiae Soc. Sci. Ups., Ser. 3, 1: 108 (1851).

≡ *Ramaria angustata* (Lév.) Corner, Beih. Nova Hedwigia 33: 242 (1970).

Phaeoclavulina apiahyna (Speg.) Giachini, **comb. nov.**

MycoBank MB512934

Basionym: *Clavaria apiahyna* Speg., Bol. Acad. Nac. Cienc. (Córdoba) 23: 435 (1919).

≡ *Ramaria apiahyana* (Speg.) Corner, Ann. Bot. Mem. 1: 555 (1950).

Phaeoclavulina argentea (R.H. Petersen) Giachini, **comb. nov.**

MycoBank MB512935

Basionym: *Ramaria argentea* R.H. Petersen, Bibl. Mycol. 79: 111 (1981).

*= *Ramaria incognita* R.H. Petersen, Bibl. Mycol. 79: 145 (1981).

*= *Ramaria incongrua* R.H. Petersen, Bibl. Mycol. 79: 147 (1981).

Phaeoclavulina articulotela (R.H. Petersen) Giachini, **comb. nov.**

MycoBank MB512936

Basionym: *Ramaria articulotela* R.H. Petersen, Bibl. Mycol. 79: 115 (1981).

Phaeoclavulina camellia (Corner) Giachini, **comb. nov.**

MycoBank MB512937

Basionym: *Ramaria camellia* Corner, Darwin. 11: 200 (1957).

Phaeoclavulina campestris (K. Yokoy. & Sagara) Giachini, comb. nov.

MycoBank MB512938

Basionym: *Ramaria zippelii* var. *campestris* K. Yokoy. & Sagara, Trans. Mycol. Soc. Japan 14: 302 (1973).

≡ *Ramaria campestris* (K. Yokoy. & Sagara) R.H. Petersen, Bibl. Mycol. 79: 57 (1981).

Phaeoclavulina campoi (Speg.) Giachini, **comb. nov.**

MycoBank MB512939

Basionym: *Clavaria campoi* Speg., Bol. Acad. Nac. Cienc. (Córdoba) 25: 28 (1921).

≡ *Ramaria campoi* (Speg.) R.H. Petersen, Bibl. Mycol. 79: 119 (1981).

Phaeoclavulina capucina (Pat.) Giachini, **comb. nov.**

MycoBank MB512940

Basionym: *Clavaria capucina* Pat., Bull. Soc. Mycol. Fr. 33: 50 (1917).

≡ *Ramaria capucina* (Pat.) Corner, Ann. Bot. Mem. 1: 565 (1950).

Phaeoclavulina cervicornis (A.L. Sm.) Giachini, **comb. nov.**

MycoBank MB512941

Basionym: *Clavaria cervicornis* A.L. Sm., J. Linn. Soc., Bot. 35: 10 (1901).

≡ *Ramaria cervicornis* (A.L. Sm.) Corner, Ann. Bot. Mem. 1: 565 (1950).

Phaeoclavulina clavarioides (Schild) Giachini, **comb. nov.**

MycoBank MB512942

Basionym: *Ramaria clavarioides* Schild, Z. Mykol. 64: 60 (1998).

Phaeoclavulina cokeri (R.H. Petersen) Giachini, **comb. nov.**

MycoBank MB512945

Basionym: *Ramaria cokeri* R.H. Petersen, Dist. Hist. Biota S. Appalachians 4: 291 (1976).

*= *Clavaria echinospora* Berk. & Broome, J. Linn. Soc., Bot. 14: 75 (1873).

≡ *Scytinopogon echinosporus* (Berk. & Broome) Corner, Ann. Bot. Mem. 1: 655. (1950).

*= *Clavaria fragillima* Sacc. & P. Syd., Syll. Fung. 16: 206 (1902).

≡ *Clavaria echinospora* Henn., Monsunia 1: 141 (1899), nom. illegit. [non *C. echinospora* Berk. & Broome 1873].

≡ *Clavariella fragillima* (Sacc. & P. Syd.) Overeem, Bull. Jard. Bot. Buitenzorg, ser. 3, 5: 275 (1923).

≡ *Ramaria fragillima* (Sacc. & Syd.) Corner, Ann. Bot. Mem. 1: 588 (1950).

Phaeoclavulina curta (Fr.) Giachini, **comb. nov.**

MycoBank MB512946

Basionym: *Clavaria curta* Fr., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 18: 31 (1861).

≡ *Ramariopsis curta* (Fr.) Corner, Ann. Bot. Mem. 1: 639 (1950).

≡ *Ramaria curta* (Fr.) Schild, Z. Mykol. 60(1): 125 (1994).

= *Clavaria myceliosa* Peck, Bull. Torrey Bot. Club 31(4): 182 (1904).
≡ *Ramaria myceliosa* (Peck) Corner var. *myceliosa*, Ann. Bot. Mem. 1: 607 (1950).
*= *Clavaria decurrens* var. *australis* Coker, Clav. U.S.: 177 (1923).
≡ *Ramaria pusilla* var. *australis* (Coker) Corner, Ann. Bot. Mem. 1: 618 (1950).
≡ *Ramaria decurrens* var. *australis* (Coker) R.H. Petersen, Bibl. Mycol. 79: 127 (1981).
= *Ramaria pusilla* Corner var. *pusilla*, Ann. Bot. Mem. 1: 617 (1950).
≡ *Clavaria pusilla* Peck, Ann. Rep. Reg. Univ. St. N.Y. 25: 83 (1873), nom. illegit. [non *C. pusilla* Pers. 1797].
≡ *Ramaria myceliosa* var. *microspora* R.H. Petersen, Bibl. Mycol. 79: 157 (1981).
*= *Ramaria subdecurrens* var. *burnhamii* R.H. Petersen, Bibl. Mycol. 79: 171 (1981).

Phaeoclavulina cyanocephala (Berk. & M.A. Curtis) Giachini, **comb. nov.**

MycoBank MB512947

Basionym: *Clavaria cyanocephala* Berk. & M.A. Curtis, J. Linn. Soc., Bot. **10: 338 (1868).**
≡ *Ramaria cyanocephala* (Berk. & M.A. Curtis) Corner, Ann. Bot. Mem. 1: 568 (1950).
≡ *Ramaria grandis* f. *cyanocephala* (Berk. & M.A. Curtis) R.H. Petersen, Bibl. Mycol. 79: 71 (1981).
*= *Clavaria grandis* **Peck,** Bull. Torrey Bot. Club 29(2): 73 (1902).
≡ *Ramaria grandis* (Peck) Corner f. *grandis*, Ann. Bot. Mem. 1: 595 (1950).
≡ *Ramaria zippelii* f. *grandis* (Peck) R.H. Petersen, Taxonomy of Fungi, (Proc. int. Symp. Madras, 1973) Part 2: 569 (1984).
*= *Clavaria spiculospora* G.F. Atk., **Ann. Mycol**. 7: 368 (1909) [cited as "*spiculisperma*" (lapsus calami) in Syll. Fung. 21: 426 (1912)].

Phaeoclavulina decolor (Berk. & M.A. Curtis) Giachini, **comb. nov.**

MycoBank MB512948

Basionym: *Clavaria decolor* Berk. & M.A. Curtis, Proc. Amer. Acad. Arts Sci. 4: 124 (1860).
≡ *Ramaria decolor* (Berk. & M.A. Curtis) R.H. Petersen, Persoonia 12(3): 231 (1984).
*= *Ramaria zippelii* var. *cristatospora* Corner, Proc. Linn. Soc. London 178: 103 (1967).
≡ *Ramaria cristatospora* (Corner) R.H. Petersen, Bibl. Mycol. 79: 64 (1981).

Phaeoclavulina echinovirens (Corner, K.S. Thind & Dev) Giachini, **comb. nov.**

MycoBank MB512950

Basionym: *Ramaria echinovirens* Corner, K.S. Thind & Dev, Trans. Br. Mycol. Soc. 40: 473 (1957).

Phaeoclavulina eumorpha (P. Karst.) Giachini, **comb. nov.**

MycoBank MB512949

Basionym: *Clavariella spinulosa* subsp. *eumorpha* P. Karst., Bidr. Kännedom Finl. Natur Folk 37: 185 (1882).
≡ *Clavaria spinulosa* subsp. *eumorpha* (P. Karst.) Sacc., Syll. Fung. 6: 701 (1888).
≡ *Clavariella eumorpha* (P. Karst.) P. Karst., Bidr. Kännedom Finl. Natur Folk 48: 388 (1889).
≡ *Ramaria eumorpha* (P. Karst.) Corner, Ann. Bot. Mem. 1: 575 (1950).
*= *Clavaria patagonica* Speg., Bol. Acad. Nac. Cienc. (Córdoba) 11: 21 (1887).
≡ *Clavulinopsis patagonica* (Speg.) Corner, Ann. Bot. Mem. 1: 383 (1950).
≡ *Ramaria patagonica* (Speg.) Corner, Darwin. 11: 203 (1957).

= *Clavaria invalii* Cotton & Wakef., Trans. Br. Mycol. Soc. 6: 176 (1919).
≡ *Clavaria flaccida* subsp. *invalii* (Cotton & Wakef.) Konrad & Maubl., Icon. Select. Fung., fasc. 4: pl.488 (1928).
≡ *Ramaria invalii* (Cotton & Wakef.) Donk, Meded. Ned. Mycol. Ver. 22:113 (1933).
≡ *Clavaria flaccida* var. *invalii* (Cotton & Wakef.) J. Favre, Mater. Fl. Crypt. Suisse 10(3): 32 (1948).
*= *Clavaria murrillii* Coker, Clav. U.S.: 190 (1923).
≡ *Ramaria murrillii* (Coker) Corner, Ann. Bot. Mem. 1: 607 (1950).

Phaeoclavulina flaccida (Fr.) Giachini, **comb. nov.**

MycoBank MB512951

Basionym: *Clavaria flaccida* Fr., Syst. Mycol. 1: 471 (1821).
≡ *Clavariella flaccida* (Fr.) P. Karst. var. *flaccida*, Revue Mycol. 3(9): 21 (1881).
≡ *Ramaria flaccida* (Fr.) Bourdot var. *flaccida*, Rev. Sci. Bourb. 11: 235 (1898).
*= "*Clavaria abietina*" sensu Fr., Syst. Mycol. 1: 469 (1821), nom. inval. [non *Clavaria abietina* Pers. 1794].
*= *Clavaria muscicola* Pers., Observ. Mycol. 2: 60 (1800).
≡ *Pistillaria muscicola* (Pers.) Fr., Syst. Mycol. 1: 498 (1821).
≡ *Typhula muscicola* (Pers.) Fr., Epicr. Syst. Mycol.: 585 (1838).
≡ *Eocronartium muscicola* (Pers.) Fitzp., Phytopathology 8: 197 (1918).
*= *Clavaria crispula* Fr., Syst. Mycol. 1: 470 (1821).
≡ *Merisma crispulum* (Fr.) Spreng. Syst. Veg. 4: 496 (1827).
≡ *Clavariella crispula* (Fr.) P. Karst., Revue Mycol. 3(9): 21 (1881).
≡ *Ramaria crispula* (Fr.) Quél., Fl. Mycol. France: 464 (1888).
≡ *Ramaria flaccida* var. *crispula* (Fr.) Schild, Hoppea 61: 317 (2000).
*= *Clavaria decurrens* Pers. Mycol. Eur. 1: 164 (1822).
≡ *Ramaria decurrens* (Pers.) R.H. Petersen var. *decurrens*, Bibl. Mycol. 79: 124 (1981).
*= *Clavaria corrugata* P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 9: 371 (1868).
≡ *Clavariella corrugata* (P. Karst.) P. Karst., Revue Mycol. 3(9): 21 (1881).
≡ *Clavaria abietina* f. *corrugata* (P. Karst.) Killerm., Denkschr. Bayr. Bot. Ges. Regensburg 15: 113 (1922).
≡ *Ramaria corrugata* (P. Karst.) Schild, Schweiz. Z. Pilzk. 53: 130 (1975).
*= *Clavariella flaccida* var. *dendroides* P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 9: 372 (1868).
*= *Clavaria muscigena* P. Karst., Not. Sällsk. Fauna Fl. Fenn. Förh. 9: 373 (1868).
≡ *Clavaria uncialis* subsp. *muscigena* (P. Karst.) Sacc., Syll. Fung. 6: 730 (1888).
≡ *Eocronartium muscigena* (P. Karst.) Höhn., Sitzungsber. K. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, 118: 1463 (1909).
*= *Eocronartium typhuloides* G.F. Atk., J. Mycol. 8: 107 (1902).
≡ *Helicobasidium typhuloides* (G.F. Atk.) Pat., Bull. Soc. Mycol. Fr. 36: 176 (1920).
*= *Clavaria subdecurrens* Coker var. *subdecurrens*, Clav. U.S.: 172 (1923).
≡ *Ramaria subdecurrens* (Coker) Corner var. *subdecurrens*, Ann. Bot. Mem. 1: 626 (1950).
*= *Ramaria ligustri* Velen., Novit. Mycol.: 162 (1939).
*= *Ramaria fuscobrunnea* Corner, in Balfour-Browne, Bull. Brit. Mus. Nat. Hist. 1: 200 (1955).
*= *Ramaria flaccida* var. *longiramosa* Corner, Beih. Nova Hedwigia 33: 250 (1970).
*= *Ramaria perfluopunicea* R.H. Petersen, New Zealand DSIR Bull. 236: 100 (1988).

Phaeoclavulina gigantea (Pat.) Giachini, **comb. nov.**

MycoBank MB512952

Basionym: *Lachnocladium giganteum* Pat., J. Bot. (Morot) 3: 34 (1889).

≡ *Ramaria gigantea* (Pat.) R.H. Petersen f. *gigantea*, Bibl. Mycol. 79: 66 (1981).

= *Lachnocladium olivaceum* Henn., Hedw. 36: 196 (1897).

= *Lachnocladium echinosporum* Bres., Ann. Mycol. 9: 551 (1911).

*= *Ramaria zippelii* var. *gracilis* Corner, Ann. Bot. Mem. 1: 635, 700 (1950).

*= *Ramaria gigantea* f. *tenuispora* R.H. Petersen, New Zealand DSIR Bull. 236: 97 (1988).

Phaeoclavulina glauco-aromatica (R.H. Petersen) Giachini, **comb. nov.**

MycoBank MB512953

Basionym: *Ramaria glauco-aromatica* R.H. Petersen, Bibl. Mycol. 79: 141 (1981).

Phaeoclavulina grandis (Corner) Giachini, **comb. nov.**

MycoBank MB512954

Basionym: *Gomphus grandis* Corner, Nova Hedwigia 18: 812 (1970).

Phaeoclavulina griseobrunnea (Singer) Giachini, **comb. nov.**

MycoBank MB512955

Basionym: *Ramaria griseobrunnea* Singer, in Singer et al., Beih. Nova Hedwigia 77: 19 (1983).

Phaeoclavulina guadelupensis (Pat.) Giachini, **comb. nov.**

MycoBank MB512956

Basionym: *Stereum guadelupense* Pat., Bull. Soc. Mycol. Fr. 15: 201 (1899).

≡ *Gomphus guadelupensis* (Pat.) D.A. Reid, Persoonia 2: 134 (1962).

*= *Nevrophyllum ochraceum* Pat., in Duss, Énum. Champ. Guadeloupe: 38 (1903).

≡ *Cantharellus ochraceus* (Pat.) Sacc. & D. Sacc., Syll. Fung. 17: 36 (1905).

≡ *Gomphus ochraceus* (Pat.) Singer, Lloydia 8: 140 (1945).

Phaeoclavulina guyanensis (Pat.) Giachini, **comb. nov.**

MycoBank MB512957

Basionym: *Lachnocladium guyanense* Pat., J. Bot. (Morot) 3: 35 (1889).

≡ *Ramaria guyanensis* (Pat.) Corner, Ann. Bot. Mem. 1: 596 (1950).

≡ *Clavaria guyanensis* (Pat.) Rick, Iheringia 5: 132 (1959).

*= *Lachnocladium leucoceras* Pat., J. Bot. (Morot) 3: 33 (1889).

≡ *Ramaria leucoceras* (Pat.) Corner, Ann. Bot. Mem. 1: 600 (1950).

Phaeoclavulina insignis (Pat.) Giachini, **comb. nov.**

MycoBank MB512958

Basionym: *Lachnocladium insigne* Pat., J. Bot. (Morot) 3: 34 (1889).

≡ *Ramaria insignis* (Pat.) R.H. Petersen, Bibl. Mycol. 79: 77 (1981), as "*insigne*".

Phaeoclavulina longicaulis (Peck) Giachini, **comb. nov.**

MycoBank MB512959

Basionym: *Clavaria longicaulis* Peck, Bull. Torrey Bot. Club 25: 371 (1898).

≡ *Ramaria longicaulis* (Peck) Corner, Ann. Bot. Mem. 1: 600 (1950).

Phaeoclavulina macrospora Brinkmann, Jber. Westf. Prov. Ver. Wiss. Kunst 25: 198 (1897).
≡ *Ramaria macrospora* (Brinkmann) Corner, Ann. Bot. Mem. 1: 603 (1950), nom. illegit. [non *R. macrospora* Velen. 1947].
= *Phaeoclavulina nigrescens* Brinkmann, Jber. Westf. Prov. Ver. Wiss. Kunst 25: 198 (1897).
≡ *Ramaria nigrescens* (Brinkmann) Donk var. *nigrescens*, Meded. Ned. Mycol. Ver. 22: 104 (1933).
= *Clavaria broomei* Cotton & Wakef., Trans. Br. Mycol. Soc. 6: 170 (1919).
≡ *Phaeoclavulina broomei* (Cotton & Wakef.) Overeem, Bull. Jard. Bot. Buitenzorg, ser. 3, 5: 277 (1923).
≡ *Ramaria broomei* (Cotton & Wakef.) R.H. Petersen, Bibl. Mycol. 79: 53 (1981).
*= *Ramaria nigrescens* var. *americana* Corner, Ann. Bot. Mem. 1: 608, 700 (1950).
≡ *Ramaria americana* (Corner) R.H. Petersen, Bibl. Mycol. 79: 48 (1981).

Phaeoclavulina mutabilis (Schild & R.H. Petersen) Giachini, **comb. nov.**
MycoBank MB512960
Basionym: *Ramaria mutabilis* Schild & R.H. Petersen, in Petersen, Bibl. Mycol. **79**: 149 (1981).

Phaeoclavulina ochracea (Bres.) Giachini, **comb. nov.**
MycoBank MB512961
Basionym: *Lachnocladium ochraceum* Bres., in Bresadola & Saccardo, **Bull. Soc. Roy. Bot. Belgique 38: 157 (1899).**
≡ *Ramaria ochracea* (Bres.) Corner var. *ochracea*, Ann. Bot. Mem. 1: 610 (1950).
*= *Clavaria intricatissima* Speg., Anales Mus. Nac. Buenos Aires 19: 279 (1909).
≡ *Ramaria intricatissima* (Speg.) Corner, Ann. Bot. Mem. 1: 598 (1950).
*= *Ramaria luteoflaccida* Corner, Ann. Bot. Mem. 1: 601, 699 (1950).
*= *Ramaria flaccida* var. *chilensis* Lazo, Mycol. 64: 77 (1972).
*= *Ramaria ochracea* var. *sicco-olivacea* R.H. Petersen, New Zealand DSIR Bull. 236: 98 (1988).

Phaeoclavulina pancaribbea (R.H. Petersen) Giachini, **comb. nov.**
MycoBank MB512963
Basionym: *Ramaria pancaribbea* R.H. Petersen f. *pancaribbea*, Bibl. Mycol. 79: 88 (1981).
*= *Ramaria pancaribbea* f. *caerulea* R.H. Petersen, Bibl. Mycol. 79: 90 (1981).

Phaeoclavulina quercus-ilicis (Schild) Giachini, **comb. nov.**
MycoBank MB512964
Basionym: *Ramaria quercus-ilicis* Schild, Z. Mykol. 64: 53 (1998).

Phaeoclavulina retispora (Corner) Giachini, **comb. nov.**
MycoBank MB512965
Basionym: *Gomphus retisporus* Corner, Ann. Bot. Mem. 2: 124 (1966).

Phaeoclavulina roellinii (Schild) Giachini, **comb. nov.**
MycoBank MB512966
Basionym: *Ramaria roellinii* Schild, Schweiz. Z. Pilzk. 56: 97 (1978).

Phaeoclavulina sikkimia (S.S. Rattan & Khurana) Giachini, **comb. nov.**
MycoBank MB512967
Basionym: *Ramaria sikkimia* S.S. Rattan & Khurana, Bibl. Mycol. 66: 18 (1978).

Phaeoclavulina subclaviformis (Berk.) Giachini, **comb. nov.**

MycoBank MB512968

Basionym: *Thelephora subclaviformis* Berk., Hooker's J. Bot. Kew Gard. Misc. 8: 238 (1856), as "*subclavaeformis*".

Note: The '*-ae-*' connective is an error, to be replaced with an '*-i-*' (McNeill et al. 2006: Art. 60.8).

≡ *Gomphus subclaviformis* (Berk.) Corner, Nova Hedwigia 18: 815 (1970), as "*subclavaeformis*".

*= *Gomphus cavipes* Corner, Nova Hedwigia 18: 808 (1970).

Phaeoclavulina tropicalis (R.H. Petersen) Giachini, **comb. nov.**

MycoBank MB512969

Basionym: *Ramaria tropicalis* R.H. Petersen, Bibl. Mycol. 79: 173 (1981).

Phaeoclavulina vinaceipes (Schild) Giachini, **comb. nov.**

MycoBank MB512970

Basionym: *Ramaria vinaceipes* Schild, Z. Mykol. 56(1): 131 (1990).

Phaeoclavulina viridis (Pat.) Giachini, **comb. nov.**

MycoBank MB512971

Basionym: *Nevrophyllum viride* Pat., J. Bot. (Morot) 2: 406 (1888).

≡ *Chlorophyllum viride* (Pat.) Murrill, North Amer. Flora 9(3): 172 (1910).

≡ *Chloroneuron viride* (Pat.) Murrill, Mycologia 3(1): 25 (1911).

≡ *Gomphus viridis* (Pat.) Singer, Lloydia 8: 140 (1945).

*= *Cantharellus patouillardii* Sacc., Syll. Fung. 9: 65 (1891).

≡ *Merulius patouillardii* (Sacc.) Kuntze, Revis. Gen. Pl. 3(2): 494 (1898).

Phaeoclavulina zealandica (R.H. Petersen) Giachini, **comb. nov.**

MycoBank MB512972

Basionym: *Ramaria pancaribbea* var. *zealandica* R.H. Petersen, New Zealand DSIR Bull. 236: 99 (1988).

Phaeoclavulina zippelii (Lév.) Overeem, Bull. Jard. Bot. Buitenzorg, ser. 3, 5: 276 (1923).

Basionym: *Clavaria zippelii* Lév., Ann. Sci. Nat., Bot. sér. 3, 2: 215 (1844).

≡ *Ramaria zippelii* (Lév.) Corner f. *zippelii*, Ann. Bot. Mem. 1: 632 (1950).

*= *Merisma guadelupense* Lév., Ann. Sci. Nat., Bot. sér. 3, 5: 157 (1846).

≡ *Pterula guadelupensis* (Lév.) Sacc., Syll. Fung. 6: 742 (1888).

≡ *Lachnocladium guadelupense* (Lév.) Pat., J. Bot. (Morot) 3: 33 (1889).

≡ *Microporus guadelupensis* (Lév.) Kuntze, Revis. Gen. Pl. 3(2): 496 (1898).

≡ *Dendrocladium guadelupense* (Lév.) Lloyd, Mycol. Writ. 5(Index): 13 (1919), as "*guadeloupe*".

≡ *Ramaria guadelupensis* (Lév.) Corner, Ann. Bot. Mem. 1: 596 (1950).

≡ *Aphelaria guadelupensis* (Lév.) Corner, Beih. Nova Hedwigia 33: 19 (1970).

*= *Clavaria nigrescens* Fr., Nova Acta Regiae Soc. Sci. Ups., Ser. 3, 1: 116 (1851).

*= *Lachnocladium hookeri* **Berk.**, Hooker's J. Bot. Kew Gard. Misc. 4: 140 (1852).

= *Clavaria thwaitesii* Berk. & Broome, J. Linn. Soc., Bot. 14: 75 **(1873).**

= *Clavaria aeruginosa* Pat., Bull. Soc. Mycol. Fr. 14: 189 (1898).

≡ *Ramaria zippellii* var. *aeruginosa* (Pat.) R.H. Petersen, Bibl. Mycol. 79: 96. 1981.

= *Clavaria phaeocladia* Pat., Bull. Soc. Mycol. Fr. 14: 189 (1898).
= *Lachnocladium albidum* Pat., Bull. Soc. Mycol. Fr. 14: 188 (1898).
*= *Lachnocladium englerianum* Henn., Bot. Jahrb. Syst. 25: 499 (1898).
*= *Lachnocladium neglectum* Massee, in Wakefield et al., Vierteljahrsschr. Naturf. Ges. Zürich 61: 630 (1916).

Turbinellus Earle, Bull. N. Y. Bot. Gard. 5: 407 (1909).

= *Cantharellus* sect. *Excavatus* A.H. Sm. & Morse, Mycologia 39: 500 (1947).
≡ *Gomphus* sect. *Excavatus* (A.H. Sm. & Morse) Corner, Ann. Bot. Mem. 2: 113 (1966).
≡ *Gomphus* subgen. *Excavatus* (A.H. Sm. & Morse) R.H. Petersen, J. Elisha Mitchell Scient. Soc. 84: 381 (1968).

Type species: *Cantharellus floccosus* Schwein. 1832.

Turbinellus flabellatus (Berk.) Giachini, **comb. nov.**

MycoBank MB512973
Basionym: *Cantharellus flabellatus* Berk., J. Linn. Soc., Bot. 16: 50 (1877).
≡ *Merulius flabellatus* (Berk.) Kuntze, Revis. Gen. Pl. 3(2): 494 (1898).
≡ *Gomphus flabellatus* (Berk.) Corner, Ann. Bot. Mem. 2: 119 (1966).
*= *Cantharellus glutinosus* Pat., Bull. Soc. Mycol. Fr. 25: 7 (1909).
≡ *Gomphus glutinosus* (Pat.) R.H. Petersen, Nova Hedwigia 21: 92 (1972).

Turbinellus floccosus (Schwein.) Earle, Bull. N.Y. Bot. Gard. 5: 407 (1909).

Basionym: *Cantharellus floccosus* Schwein. f. *floccosus*, Trans. Amer. Phil. Soc. 4: 153 (1832).
≡ *Merulius floccosus* (Schwein.) Kuntze, Revis. Gen. Pl. 2: 862 (1891).
≡ *Chanterel floccosus* (Schwein.) Murrill, N. Amer. Flora 9(3): 168 (1910).
≡ *Gomphus floccosus* (Schwein.) Singer f. *floccosus*, Lloydia 8: 140 (1945).
≡ *Nevrophyllum floccosum* (Schwein.) R. Heim, Revue Mycol. 19: 51 (1954).
= *Cantharellus canadensis* Klotzsch, in Berkeley, Ann. Nat. Hist. 3: 380 (1839).
≡ *Craterellus canadensis* (Klotzsch) Sacc., Syll. Fung. 6: 519 (1888).
≡ *Trombetta canadensis* (Klotzsch) Kuntze, Revis. Gen. Pl. 2: 873 (1891).
≡ *Gomphus canadensis* (Klotzsch) Corner, Ann. Bot. Mem. 2: 116 (1966).
= *Cantharellus princeps* Berk. & M.A. Curtis, Ann. Mag. Nat. Hist., ser. 3, 4: 293 (1859).
≡ *Merulius princeps* (Berk. & M.A. Curtis) Kuntze, Revis. Gen. Pl. 2: 862 (1891).
*= *Cantharellus bonarii* Morse, Mycologia 22: 219 (1930).
≡ *Gomphus bonarii* (Morse) Singer f. *bonarii*, Lloydia 8: 140 (1945).
*= *Cantharellus floccosus* f. *excavatus* A.H. Sm. & Morse, Mycologia 39: 525 (1947).
≡ *Gomphus floccosus* f. *excavatus* (A.H. Sm. & Morse) Corner, Ann. Bot. Mem. 2: 121 (1966).
*= *Cantharellus floccosus* f. *rainieriensis* A.H. Sm. & Morse, Mycologia 39: 521 (1947).
≡ *Gomphus floccosus* f. *rainieriensis* (A.H. Sm. & Morse) Corner, Ann. Bot. Mem. 2: 121 (1966), as "*raineriensis*".
≡ *Gomphus floccosus* subsp. *rainieriensis* (A.H. Sm. & Morse) R.H. Petersen, Nova Hedwigia 21: 48 (1972).
*= *Cantharellus floccosus* f. *wilsonii* A.H. Sm. & Morse, Mycologia 39: 523 (1947).
≡ *Gomphus floccosus* f. *wilsonii* (A.H. Sm. & Morse) Corner, Ann. Bot. Mem. 2: 121 (1966).

≡ *Gomphus bonarii* f. *wilsonii* (A.H. Sm. & Morse) R.H. Petersen, Nova Hedwigia 21: 37 (1972).

*= *Cantharellus wilkinsiae* Morse, in Smith & Morse, Mycologia 39: 528 (1947), as "*wilkinsae*".

≡ *Gomphus wilkinsiae* (Morse) Corner, Ann. Bot. Mem. 2: 128 (1966), as "*wilkinsae*".

≡ *Gomphus bonarii* f. *wilkinsiae* (Morse) R.H. Petersen, Nova Hedwigia 21: 35 (1972), as "*wilkinsae*".

*= *Gomphus floccosus* f. *cystidiophorus* R.H. Petersen, J. Elisha Mitchell Scient. Soc. 84: 376 (1968).

*= *Gomphus megasporus* Corner, Nova Hedwigia 18: 813 (1970).

*= *Gomphus bonarii* f. *novamexicanus* R.H. Petersen, Nova Hedwigia 21: 44 (1972).

*= *Gomphus floccosus* f. *coccineobasalis* R.H. Petersen, Nova Hedwigia 21: 52 (1972), as "*coccineo-basalis*".

*= *Gomphus floccosus* f. *olivaceus* R.H. Petersen, Nova Hedwigia 21: 54 (1972).

*= *Gomphus szechwanensis* R.H. Petersen, Nova Hedwigia 21: 102 (1972).

*= *Gomphus thiersii* R.H. Petersen, Evol. Higher Basidio.: 363 (1971).

Turbinellus fujisanensis (S. Imai) Giachini, **comb. nov.**

MycoBank MB512974

Basionym: *Cantharellus fujisanensis* S. Imai, Bot. Mag.Tokyo 55: 519 (1941).

≡ *Nevrophyllum fujisanense* (S. Imai) S. Ito, Mycol. Fl. Japan 2(4): 103 (1955), as "*fujisanensis*".

≡ *Gomphus fujisanensis* (S. Imai) Parmasto, Ident. URSS Clav.: 28 (1965).

Turbinellus kauffmanii (A.H. Sm.) Giachini, **comb. nov.**

MycoBank MB512975

Basionym: *Cantharellus kauffmanii* A.H. Sm., in Smith & Morse, Mycologia 39: 516 (1947).

≡ *Gomphus kauffmanii* (A.H. Sm.) Corner, Ann. Bot. Mem. 2: 122 (1966).

Turbinellus stereoides (Corner) Giachini, **comb. nov.**

MycoBank MB512976

Basionym: *Gomphus stereoides* Corner, Ann. Bot. Mem. 2: 124 (1966).

*= *Gomphus brasiliensis* Corner, Nova Hedwigia 18: 807 (1970).

Discussion

Hibbett et al. (1997), Pine et al. (1999), Humpert et al. (2001), Giachini (2004), and now Giachini et al. (2010) have shown that evolutionarily the genus *Ramaria,* long recognized as having morphological features similar to *Gomphus* s.l., is closely related to species of that genus. Aside from the overall evolutionary relationships of *Gomphus* s.l. and *Ramaria*, Giachini (2004) revealed in particular a closer relationship between some species of *Gomphus* s.l. and species of *Ramaria* subgen. *Echinoramaria* (Giachini et al. 2010: figs. 1–2). Of the genera treated here, *Gomphus* s.s. and *Phaeoclavulina* share the most macro- and microscopic features. Although *Phaeoclavulina* is mostly ramarioid, it also includes a few pileate species previously placed in *Gomphus* s.l. Both *Gomphus* s.s. and *Phaeoclavulina* have uni- and multi-pileate species that

present fan- to funnel-shaped, glabrous to subtomentose or floccose-squamose pilei. Nearly all species have decurrent hymenia with wrinkled hymenial folds, and all species possess clamp connections.

Gomphus s.s. and *Gloeocantharellus* are fairly easily differentiated by abundance of gleoplerous hyphae and clamp connections: *Gomphus* s.s. has ubiquitous clamp connections, whereas these structures are present only irregularly in *Gloeocantharellus*. *Gloeocantharellus* is characterized by abundant gleoplerous hyphae dispersed among all hyphal tissues, separating it from other genera in the *Gomphaceae*.

Turbinellus was proposed by Earle (1909) to accommodate *Cantharellus floccosus*. Earle (1909) assigned three species to his genus, all from North America. *Turbinellus* species were later transferred to *Gomphus* (Singer 1945), then *Cantharellus* (Smith & Morse 1947), *Nevrophyllum* (Heim 1954: only *T. floccosus*), and finally back to *Gomphus* (Corner 1966). The taxonomy of its species has been challenging, primarily to the lack of morphological features sufficiently reliable to differentiate species, resulting in many nomenclatural synonyms.

The morphological and genetic sampling of all species, forms, and subspecies by Giachini (2004), Giachini et al. (2010), and this study support the new generic circumscriptions reflected here. Many species previously delimited on morphological grounds have been shown to represent phenotypic variants of a few well-supported genetic taxa. Genetic data indicate that *Gomphus bonarii* and *G. floccosus* (and all their forms and subspecies) represent phenotypes of a single species (Giachini et al. 2010). Hence, *G. bonarii* and *G. floccosus* (and all their variants), long thought to be different species but seldom correctly separated on morphological grounds, are synonymized, with the name *Turbinellus floccosus* having priority. Even though Giachini (2004: fig. 3) presented three clades of *bonarii/floccosus* species, the overall morphological similarities (e.g., basidioma morphology, spore size, hyphal arrangement) combined with the inconsistent arrangement of species/subspecies within and among each of those clades, imply that those species/subspecies are sufficiently similar to comprise one single taxon.

The overall conclusions indicate an intricate organization for *Gomphus* s.l. and its counterparts. Additional studies, focusing on generic and species distribution, are undoubtedly necessary.

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