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THREE INTERESTING THERMOPHILIC TAXA OF GYMNOPUS (BASIDIOMYCETES, TRICHOLOMATACEAE): G. PUBIPES SP. NOV., G. PUBIPES VAR. PALLIDOPILEATUS VAR. NOV. AND G. DRYOPHILUS VAR. LANIPES COMB. NOV.

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Abstract Three *Gymnopus*-taxa (Basidiomycetes, Tricholomataceae) were studied. One new species, *G. pubipes*, is described for a thermophilic fungus usually erroneously identified as *G. benoistii*. This study is based on studies of the original description of the latter species and recently collected material from Spain. A macroscopically different but microscopically identical fungus recorded in the Czech Republic, Romania, Slovakia and Sweden is described as *G. pubipes* var. *pallidopileatus*. A new combination, *G. dryophilus* var. *lanipes*. is also proposed and its neotype from a recent collection from Spain is designated here.

Key words: Agaricales, new taxa, type-revision, taxonomy, nomenclature.

Introduction

During the past years, we collected three taxa of the genus *Gymnopus* (Pers.) Roussel in Mediterranean and Central-European thermophilic ecosystems. They have been named *Gymnopus* (or *Collybia*) *benoistii* or *G.* (*C.*) *dryophilus* var. *lanipes*, respectively, in most recent mycological literature (MALENÇON & BERTAULT 1975;

MORENO ET AL. 1990; ORTEGA ET AL. 1991; ANTONÍN & NOORDELOOS 1997; BON 1999; HAUSKNECHT & KRISAI-GREILHUBER 2000). To clarify the taxonomic position of these taxa, we made a comparative study of collections from different European countries, as well as of the type material.

The type material of *C. benoistii* Boud. is apparently not preserved, at least not in Boudier's herbarium deposited in the herbarium of the Museum of Natural History in Paris (PC), so this species has to be interpreted only according to the original description (BOUDIER 1900). Most fungi identified in recent years as *C. benoistii* (see references above) agree only partially with Boudier's species, and his original diagnosis does not include data on some essential characters in *Gymnopus* taxonomy, e.g. the type of pileipellis or its reaction with KOH. Regarding those circumstances, we decided to describe the new species *Gymnopus pubipes*, which includes the concept of *C. benoistii* of many European mycologists.

The type collection of *Marasmius dryophilus* var. *lanipes* Malençon et Bertault preserved in the herbarium in Montpellier (MPU) was studied and compared with recent Italian and Spanish samples. Unfortunately, the holotype does not correspond to the original diagnosis (MALENÇON & BERTAULT 1975: 362). Therefore, a neotype was designated from Spanish material, as no paratypic collections exist in Montpellier Herbarium.

Material and methods

Gymnopus pubipes and *G. dryophilus* var. *lanipes* have a wide distribution in the Mediterranean countries (southern Europe and northern Africa) and one variety of the first one (see below) also in thermophilous associations (oak and hornbeam-oak stands) in Central and Northern Europe (Austria, Czech Republic, Romania, Slovakia, Sweden). Most Spanish localities of the latter species were recorded in Mediterranean ecosystems in Andalucía (Granada, Málaga) and Castilla-La Mancha (Guadalajara), whereas the material of *Gymnopus dryophilus* var. *lanipes* comes from southern Spain (Andalucía, provinces of Granada, Málaga and Sevilla), as well as from Italy (material previously studied and published by LONATI 1986).

Microscopic slides of dried material were prepared with 5% NH_4OH, Melzer´s reagent and Congo Red in 10% ammonia. Macroscopic reactions on the pileus of the samples were tested with a 10% KOH solution. Drawings were made with the aid of Zeiss (A.O. and F.E.-R.) and Olympus (V.A.) drawing tubes under an oil-immersion lens. Colours of basidiomata were compared with KORNERUP & WANSCHER (1973). Spore measurements are given according to HEINEMANN & RAMMELOO (1985). Herbarium acronyms are according to HOLMGREN ET AL. (1990). Abbreviations of authors of fungal names follow KIRK & ANSELL (1992).

Apart from other references cited in the text, we have followed the general taxonomic criteria proposed in the European *Collybia* s. l. monograph by ANTONÍN & NOORDELOOS (1997), and the essential treatise for Mediterranean agarics by MALENÇON & BERTAULT (1975).

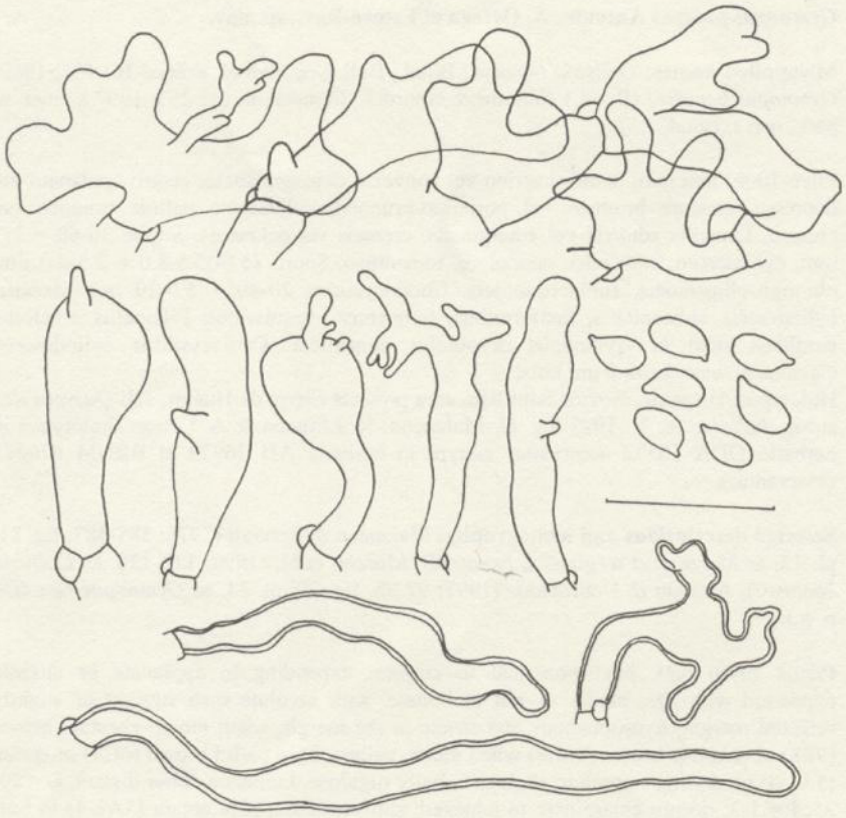
***Gymnopus pubipes* Antonín, A. Ortega et Esteve-Rav., sp. nov.**

Misapplied names: *Collybia benoistii* Boud., Bull. Soc. mycol. France 16: 102, 1900; *Gymnopus benoistii* (Boud.) Antonín & Noordel., Mycotaxon 63: 363. 1997 s. auct. p. part., non s. Boud.

Pileo 10-40 mm lato, hemisphaerico vel convexo, dein applanato, centro applanato vel depresso, obscure brunneo vel purpureo-brunneo, pallescente pallide brunneo vel cremeo. Lamellis adnexis vel emarginatis, cremeis vel ochraceis. Stipite 20-60 × 2-7 mm, cylindraceo, cum pileo concolore, tomentoso. Sporis (5.0-)5.5-8.0 × 2.5-4.0 µm, oblongis-ellipsoideis, sublacrimoideis. Cheilocystidiis 20-40 × 5.0-20 µm, clavatis, cylindraceis, subcapitatis, fusiformibus, frequenter irregularibus. Pileipellis e cellulis similibus sicut in Gymnopus dryophilus constructa. Caulocystidiis cylindraceis, clavatis, obtusis, 3.0-8.0 µm latis.
Holotypus: Hispania, Huétor-Santillán, area protecta Sierra de Huétor, sub *Quercus ilex* subsp. *ballota*, 18. X. 1977 leg. G. Malençon, X. Llimona & A. Ortega (holotypus in herbario GDA 10332 asservatur, isotypi in herbaria AH 26979 et BRNM 670685 asservantur).

Selected descriptions and iconography: Malençon & Bertault (1975: 385-387, fig. 81, pl. 15, as *Marasmius terginus* f. *benoistii*); Moreno et al. (1990: 118-120, as *Collybia benoistii*); Antonín & Noordeloos (1997: 97-98, fig. 29, pl. 24, as *Gymnopus benoistii* p. p.).

Pileus 10-40 mm, hemisphaerical to convex, expanding to applanate or slightly depressed with age, hardly or not umbonate, with involute then straight or slightly reflexed margin, hygrophanous and striate at the margin when moist, chestnut-brown (9E8) or purplish-brown (10E8) when moist, pallescent to pallid brown (6C8) or cream (5A3-4) on drying, smooth to slightly radially rugulose. Lamellae rather distant, L = 20-25, l = 1-3, deeply emarginate to adnexed, subventricose, pale cream (5A3-4) to buff (6C6-8), often showing a pale reddish reflection, with entire to slightly sinuose edge. Stipe 20-60 × 2-7 mm, cylindrical, often compressed, tenacious, whitish to pale cream when young, becoming concolorous with pileus with age, entirely pubescent, densely tomentose towards the base, with fine white to cream coloured hairs; white rhizoids often present at the base. Context concolorous with surface. Smell and taste indistinct.
Spores (5.0-)5.5-8.0 × 2.5-4.0 µm, X = 6.5 × 3.4 µm, E = 1.6-2.3, Q = 1.9, oblong-ellipsoid to sublacrymoid, smooth, hyaline, non-amyloid. Basidia 18-25 × 5.0-7.5 µm, 4-spored, clavate. Basidioles 12-30 × 3.0-8.0 µm, cylindrical to clavate. Lamella edge sterile. Cheilocystidia 20-40 × 5.0-20 µm, very variable in form, mostly clavate to subcapitate, cylindrical to fusiform, sometimes irregular, lobate or with several wide projections. Pileipellis with typical dryophila-structure, composed by cylindrical to inflated up to 15 µm wide hyphae, with lobate to coralloid terminal elements up to 20 µm wide, showing incrusting pigment. Stipitipellis a cutis, of cylindrical, parallel, slightly thick-walled, up to 5.0 µm wide hyphae. Caulocystidia very numerous, 3.0-8.0 µm wide, polymorphic, sinuose, usually cylindrical to clavate, with obtuse apex, slightly thick-walled, sometimes septate, sometimes with obtuse projections at the apex. Clamp-connections present in all tissues. Chemical reactions: KOH reaction on pileus green.



Gymnopus pubipes (holotype): pileipellis, cheilocystidia, spores and caulocystidia. Scale bar = 20 µm.

Ecology: Often gregarious, saprotrophic on vegetal debris (leaves, branches), especially of *Quercus* or *Pinus*, or in mixed stands, sometimes under *Juniperus*, in thermophilous forests on calcareous soils.
Distribution and phenology: Widespread in southern Europe and northern Africa. Autumn to early winter in the Mediterranean region.

Material studied: SPAIN: Granada: Huétor-Santillán, Parque natural de la Sierra de Huétor, road to campamento de la Alfaguara, under *Quercus ilex* subsp. *ballota*, 18 Oct. 1977 leg. G. Malençon, X. Llimona and A. Ortega (holotype GDA 10332, isotypes AH 26979 and BRNM 670685); Baza, Parque natural de la sierra de Baza, pinar de Cala, under *Juniperus communis*, 3 Nov. 1992 leg. A. Ortega and D. Sousa (GDA 36231); Lanteira, Parque natural de Sierra Nevada, under *Salix atrocinerea* in *Pinus* forest, 13 Nov. 1999 leg. A. Capilla, F. Esteve-Raventós and A. Ortega (GDA 44742); Juviles, Parque natural de Sierra Nevada, under *Pinus sylvestris*, 28 Oct. 2000 leg. L. Alcoba and A. Ortega (GDA 44743); Guadalajara: Albalate de Zorita, under *Quercus ilex*

subsp. *ballota*, 15 Oct. 1999 leg. V. Bandala, F. Esteve-Raventós, L. Montoya and M. Villarreal (AH 26931).

The fungus described above represents a "Mediterranean type" of this species. A fungus with totally identical microscopic features grows in thermophilous stands of Central Europe and southern parts of northern Europe. However, it differs by macroscopic features, especially the colour of carpophores. Therefore, we decided to describe it as a new variety of *G. pubipes*.

***Gymnopus pubipes* var. *pallidopileatus* Antonín, A. Ortega et Esteve-Rav., var. nov.**

A varietate typica carpophoris parvis et pallide coloratis differt.
Holotypus: Cechia, Moravia, Ochoz prope Brno, area protecta Hornek, ad folia deiecta *Quercus*, 20. VI. 2001 leg. A. Vágner (holotypus in herbario BRNM 667673 asservatur).

Selected descriptions and iconography: Antonín & Noordeloos (1997: 97-98, fig. 29, pl. 24, as *Gymnopus benoistii* p. p.).

It differs from the typical variety in having a smaller, 15-30 mm broad pileus, coloured brown (6C5) at centre, paler (pale cream, beige or whitish) towards margin, paler lamellae (paler than 4A2) and paler stipe, almost whitish above and brown (6C4-5) towards base. Its microscopic features fully agree with var. *pubipes*.
Ecology: It grows on fallen *Quercus*-leaves, rarely on leaves of other broad-leaved trees (*Acer campestre, Carpinus*).
Distribution and phenology: It is known from Central Europe (Austria, Czech Republic, Romania and Slovakia) and southern Sweden. It has been recorded in spring and summer (May to August).

Material studied: CZECH REPUBLIC: Hlásná Třebáň, 27 May 1945 leg. V. Vacek (PRM); Ochoz near Brno, Údolí Říčky nature reserve, Lysá hora, on fallen leaves and twigs in a *Carpinus-Quercus* stand, 19 July 2000 leg. V. Antonín and A. Vágner (Antonín 00.25, BRNM 652808); Ochoz near Brno, Hornek nature reserve, on fallen leaves of *Carpinus, Quercus* and *Acer campestre*, 29 July 2000 leg. A. Vágner (BRNM 652989) and 20 June 2001 leg. A. Vágner (BRNM 667673, holotype); Moravský Krumlov, Krumlovsko-rokytenské slepence nature reserve, on fallen leaves of *Quercus*, 23 Aug. 2001 leg. V. Antonín and Z. Bieberová (Antonín 01.210, BRNM 666476); Kobylí na Mor., Ochozy, on *Quercus* leaves, 12 June 1994 leg. V. Antonín 94.53 (BRNM 599017); Valtice, Rendezvous, in *Quercus* leaves, 18 June 1993 leg. H. Deckerová (Antonín 93.30 and 31, BRNM 576463 and 576464). **ROMANIA:** Bucureşti, destination Piteşti, 14 July 1976 leg. J. Kubička (PRM). **SLOVAKIA:** Nitra, Zobor, 3 June 1972 leg. L. Opold (BRA). **SWEDEN:** Västergötland, Lötene, Medelplana, Munkängarnas naturreservat, on *Quercus* leaves, on limestone, 29 July 1985 leg. L. & A. Stridvall 83/003 (herb. Stridvall, L, BRNM 603950).

Gymnopus pubipes is characterised by a more or less uniformly reddish-brown pileus (var. *pubipes*) or a pileus brown at centre and beige, pale cream to whitish

towards margin (var. *pallidopileatus*), a strongly pubescent to velutinous stipe, a dryophila-type pileipellis, clavate to subcapitate, cylindrical to fusiform, sometimes irregular cheilocystidia and a green reaction of the pileus surface and pileipellis with KOH. *Gymnopus fuscopurpureus* (Pers.: Fr.) Antonín et al. (= *Collybia obscura* J. Favre) represents a close taxon. It can sometimes be found in the same habitats and shows the same green reaction on the pileus with KOH. The species differ in the colours of the basidiomata, stipe covering and size and shape of cheilocystidia. *Gymnopus pubipes* belongs to the subsect. *Alkalivirentes* Antonín et Noordel. having a dryophila-type pileipellis and green chemical reaction on the pileus (ANTONÍN & NOORDELOOS loc. cit.).

As previously stated in the introductory chapter, *G. pubipes* has regularly been identified as *Collybia* (or *Gymnopus*) *benoistii* (MORENO ET AL. 1990; ANTONÍN & NOORDELOOS 1997) or *Marasmius terginus* f. *benoistii* (Boud.) Malençon et Bertault (MALENÇON & BERTAULT 1975). All these authors indicate a spore size ranging (5.5-)6-9(-11) × 3-4(-5) µm, although information about the KOH reaction on the pileus is lacking or said to be absent (ANTONÍN & NOORDELOOS loc. cit.). The most recent record of this fungus was published by HAUSKNECHT & KRISAI-GREILHUBER (2000) with a sporal range of 6-8 × 3-3.5 µm, which agrees with our observations (it represents var. *pallidopileatus*). BON's (1999) concept of *C. benoistii* is rather similar to that of BOUDIER (1900) because he refers to a species with much larger spores [(8-)9-10(-11) × (3.5-)4-5(-6) µm].

MALENÇON & BERTAULT (loc. cit.) and ORTEGA ET AL. (1991) subordinated *C. benoistii* to *Marasmius terginus* (Fr.) Fr. or *Collybia tergina* (Fr.) S. Lundell as a form or variety, respectively. However, the pileipellis of the *tergina* group is rather different from our former concept of *C. benoistii* (= *Gymnopus pubipes*), as already remarked by ANTONÍN & NOORDELOOS (loc. cit.).

Unfortunately, the absence of type material in Boudier's herbarium does not allow to have a correct picture of what *C. benoistii* might represent – mainly regarding the reaction of the pileus with KOH, the type of pileipellis and the spore size, which are very important characters in *Gymnopus* taxonomy. Boudier's species could also be related to some other taxon of *Gymnopus* sect. *Vestipedes* (Fr.) Antonín et al. or sect. *Levipedes* (Fr.) Halling and, in our opinion, should be best regarded as a *nomen dubium*.

***Gymnopus dryophilus* var. *lanipes* (Malençon et Bertault) A. Ortega, Antonín et Esteve-Rav., comb. nov.**

Basionym: *Marasmius dryophilus* var. *lanipes* Malençon et Bertault, Trav. Inst. Sci. Cherif. Fac. Sci. Rabat 33 (Fl. Champ. Supér. Maroc 2): 362, 1975.

= *Collybia dryophila* var. *lanipes* (Malençon et Bertault) A. Ortega et Vizoso, Doc. Mycol. 21(82): 23, 1991.

Neotype (selected here): Spain, Málaga, Road Málaga-Colmenar, venta de Garvey, in *Pinus* forest, 10 Nov. 2000, leg. L. Alcoba and A. Ortega, GDA 44739 (isoneotypes AH 26980 and BRNM 670686).

Selected descriptions and iconography: Malençon & Bertault (1975: 361-364, fig. 77, as *Marasmius dryophilus* var. *lanipes*); Lonati (1986: 15-17, as *Marasmius dryophilus* var. *lanipes*).

Pileus 12-45 mm, convex to plano-convex, later applanate or slightly depressed around the centre, with inflexed, then straight margin, hygrophanous, translucently striate at the margin (sometimes reaching half of the pileus) when moist, entirely orange-brown to ochraceous-brown when humid (7-8E8), strongly pallescent on drying, becoming yellow-ochraceous to cream (5A3-4), smooth, glabrous. Lamellae moderately crowded, adnate to emarginate, narrow, segmentiform or slightly ventricose, whitish (5A1), with entire to subentire concolorous edge. Stipe 30-65 × 3-8.5 mm, cylindrical to broadened towards the base, subconcolorous to paler than the pileus, brown-orange to ochraceous-yellow, whitish at the apex, surface finely pubescent, especially near the base, never tomentose, whitish rhizoids present at the base. Context concolorous with surface. Smell and taste indistinct.

Spores (3.8-)4.5-7.2(-8.0) × 2.2-3.5 µm, Xm = 5.2 × 2.8 µm, E = 1.6-2.3, Q = 1.85, oblong-ellipsoid to (sub-)lacrimoid, smooth, hyaline, non-amyloid. Basidia 23-31 × 5.0-6.0 µm, 4-spored, clavate. Basidioles 15-32 × 2.5-7.0 µm, cylindrical to clavate, less frequently subfusoid. Cheilocystidia rather inconspicuous, 18-25 × 4.0-7.0 µm, cylindrical, more rarely subclavate, mostly furcate to lobate, irregular or diverticulate. Trama hyphae cylindrical, non-dextrinoid, up to 12 µm wide. Pileipellis typically "jigsaw puzzle-like"(dryophila-type), with strongly diverticulate elements, smooth or incrusted. Stipitipellis a cutis, of cylindrical, parallel, slightly thick-walled, up to 5.0 µm wide hyphae. Hairs of the stipe covering up to 50 × 1.0-5.0 µm, filiform or vermiform, thin- to moderately thick-walled, arising from clusters of diverticulate terminal elements, similar to cheilocystidia. Clamp-connections present in all tissues.

Chemical reactions: KOH on pileus none.

Ecology: Gregarious in Mediterranean thermophilous forests among vegetal debris, especially of *Quercus ilex*, *Pinus*, or more rarely *Cistus*.

Distribution and phenology: Known from northern Africa (Mauritania), and southern Europe (France, Italy and Spain).

Material studied: ITALY: Roma: Villa Ada, under *Robinia pseudoacacia*, *Laurus nobilis* and *Quercus ilex*, 8 Nov. 1983 leg. G. Lonati (herb. Lonati, duplicate AH). **SPAIN:** Granada: Sierra Elvira, under *Quercus ilex* subsp. *ballota*, 28 Oct. 1979 leg. R. Galán (GDA 10328); Bolones, Parque natural de la Sierra de Huétor, under *Pinus halepensis*, 2 Jan. 1996 leg. L. Alcoba and A. Ortega (GDA 42754, AH 25268); Málaga: Yunquera, parque natural de la Sierra de las Nieves, puerto de la Caína, under *Cistus albidus*, 30 Nov. 1995 leg. F. Esteve-Raventós, E. Horak, G. Moreno and A. Ortega (GDA 44974); Road Málaga-Colmenar, venta de Garvey, in *Pinus* forest, 10 Nov. 2000 leg. L. Alcoba and A. Ortega (neotype GDA 44739, isoneotypes AH 26980 and BRNM 670686); Sevilla: Aznalcázar, pinar de Aznalcázar, under *Pinus pinea*, 18 Nov. 2000 (GDA 44740) and 31 March 2001 (GDA 44741) leg. L. Alcoba and A. Ortega.

This poorly known taxon was described in detail by MALENÇON & BERTAULT (1975), putting special emphasis to the presence of a finely velutinous stipe, the covering formed by cylindrical, thin-walled hairs or caulocystidia. There is no doubt that the original description represents the well-known *G. dryophilus*, except for the pubescent stipe. The material studied by us differs from the typical *G. dryophilus* also in having smaller cheilocystidia and longer basidia.

Gymnopus dryophilus var. *lanipes* (neotype): pileipellis cells (upper left), cheilocystidia (lower left), spores and hairs of the stipe cover (right). Scale bar = 20 µm.

The material deposited as a holotype (nº 4508) in Malençon's herbarium at Montpellier (MPU) was studied by us, and it does not correspond to the taxon described in the protologue. Although it has a pubescent stipe, its spores are larger (9-11 × 4-5 µm), the pileipellis is a cutis of typical filamentous hyphae without a dryophila-structure, and the basidiomata are brown-reddish. These characters do not agree with *G. dryophilus*, but it may represent a taxon from the *G. terginus* group. Because Malençon knew *G. terginus* very well, a designation of such material was surely an unintentional error. Therefore, because of the absence of any paratypic collection, we selected a neotypus from Iberian material which fits the original description in all aspects, and keeps the originally used name.

Gymnopus dryophilus var. *lanipes* might be confused with pale or dehydrated forms of *G. pubipes*, both sharing a pubescent stipe. *Gymnopus dryophilus* var. *lanipes* can be distinguished macroscopically by the whitish to cream lamellae and the absence of rhizoids at the stipe base, and microscopically by its smaller spores and the inconspicuous cylindrical, often diverticulate cheilocystidia. Moreover, the chemical reaction with KOH on the pileus is a good character to distinguish both species.

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