

***Panellus ringens* and *P. violaceofulvus* (Agaricales, Mycenaceae) from Slovakia: morphological and ecological aspects**

Soňa Jančovičová^{1*}, Drahoš Blanár², Stanislav Glejdura³, Vladimír Kunca⁴

¹Department of Botany, Faculty of Natural Sciences, Comenius University in Bratislava, Révová 39,
811 02 Bratislava, Slovak Republic

²Administration of the Muránska planina National Park, J. Kráľa 12, 050 01 Revúca, Slovak Republic
³962 37 Kováčová, Slovak Republic

⁴Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, T. G. Masaryka 24, 960 53
Zvolen, Slovak Republic

Abstract

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Species *Panellus ringens* and *P. violaceofulvus* are similar in some respects and different in others. They look alike macroscopically, especially in having pleurotoid habit and violet-brown and/or red-brown colours of basidiomata, but differ microscopically, distinctly in size of spores. For each species, description and illustration of macroscopic and microscopic characters are provided based on the Slovak collections. Some misidentifications are mentioned and crucial morphological characters stressed. Compared and commented are also the characters used for differentiation of both species in the selected literature. The added distributional and ecological data concern the area of Slovakia and Europe. *Panellus ringens* is proposed to be included in a new version of the Red list of fungi of Slovakia.

Key words

Basidiomycota, Europe, fungi, identification, microscopy

Introduction

Panellus P. Karst. is a genus within Mycenaceae (Agaricales, fungi) characterized by a pleurotoid habit of basidiomata, i.e. with lateral or absent stipe. Comparing with *Sarcomyxa* P. Karst. and *Tectella* Earle (the other genera within Mycenaceae with pleurotoid habit), pileus is thin-fleshed, up to 2 mm thick, veil absent, and basidiomata are coloured in shades of white, yellow-brown, violet-brown and/or red-brown (Vesterholt, 2012).

In Europe, four species of the genus *Panellus* occur: *P. mitis* (Pers.) Singer with whitish-coloured basidiomata, *P. stipticus* (Bull.) P. Karst. with yellow-brown basidiomata and *P. ringens* (Fr.) Romagn. and *P. violaceofulvus* (Batsch) Singer with violet-brown

and/or red-brown basidiomata (Vesterholt, 2012). In Slovakia, *P. mitis* and *P. stipticus* seem to be common and well-known species, e.g. there are about 40 records of *P. mitis* and 280 for *P. stipticus* in ŠKUBLA (2003).

The knowledge on *P. ringens* and *P. violaceofulvus* is, however, scant. We knew only three published collections of *P. ringens* from the years 1972 and 2006 (KAUTMANOVÁ, 2006) and 17 of *P. violaceofulvus* from the years 1914–2006 (RIPKOVÁ et al., 2007) before our study.

What is the reason for such a low number of collections? Are these species rare or overlooked? Do they have special requirements for habitats and/or substrate? Are they clearly delimited? Can they be simply recognized using prevalent literature for identification of fungal taxa?

*Corresponding author:
e-mail: sona.jancovicova@fns.uniba.sk

To answer these questions – in order to better understand the morphological features and ecological requirements of *P. ringens* and *P. violaceofulvus*, we aimed our work to: 1) gather recent information about the species, i.e. to search for more published records and to process new (mostly our own) collections, 2) describe and illustrate macro- and microscopic characters of *P. ringens* and *P. violaceofulvus* based on the Slovak collections, 3) stress crucial morphological characters for their differentiation, 4) compare the distinguishing characters with those used in the literature, 5) summarise the occurrence and ecological requirements of the species in Slovakia, 6) consider reasons for including the species into a new version of Red list of fungi of Slovakia, 7) add data on species occurrence, ecology and threat in Europe.

Material and methods

The studied material includes specimens of *Panellus ringens*, *P. violaceofulvus* and *Phyllostopsis nidulus* collected in Slovakia. The specimens are kept in the institutional herbaria SAV, SLO and private herbaria PVKU (herbarium of V. Kunca) and PSG (herbarium of S. Glejdura). The herbarium acronyms follow Thiers (2016). The description of macroscopic characters is based on fresh material. Three selected dried specimens were used to describe microscopic characters of *Panellus ringens* (SLO 787, SLO 788, and SLO 790) and of *P. violaceofulvus* (SLO 789, SLO 1449, and SAV 10487). Microscopic mounts were prepared in Congo red after a short pre-treatment in 3% aqueous solution of KOH and observed under an Olympus BX41 and CX41 light microscopes with an oil-immersion lens at a magnification of 1,000 ×. Drawings of all microscopic structure, with exception of spores, were made with a camera lucida using an Olympus U-DA drawing attachment at a projection scale of 2,000 ×. Spores were drawn from scanned and enlarged pictures by an Artray Artcam 300 MI camera. Statistic calculations of all microscopic characters are based on 20–30 measurements per specimens and given as minimum, maximum (in parentheses), average ± standard deviation and average (av.) values. Abbreviations: Q = ratio of length and width of spores, L = number of lamellae reaching the point of attachment, l = number of lamellulae between each pair of lamellae. Descriptive terminology is adopted from Vellinga (1988). Nomenclature of fungal taxa follows KNUDSEN and VESTERHOLT (2012).

Results and discussion

Panellus ringens (Fr.) Romagn., Bull. Trimest. Soc. Mycol. Fr. 61: 38 (1945)

Description (Figs 1, 2)



Fig. 1. *Panellus ringens*: basidiomata (Stolické vrchy Mts, 21 September 2012, PVKU 747). Photo V. Kunca.

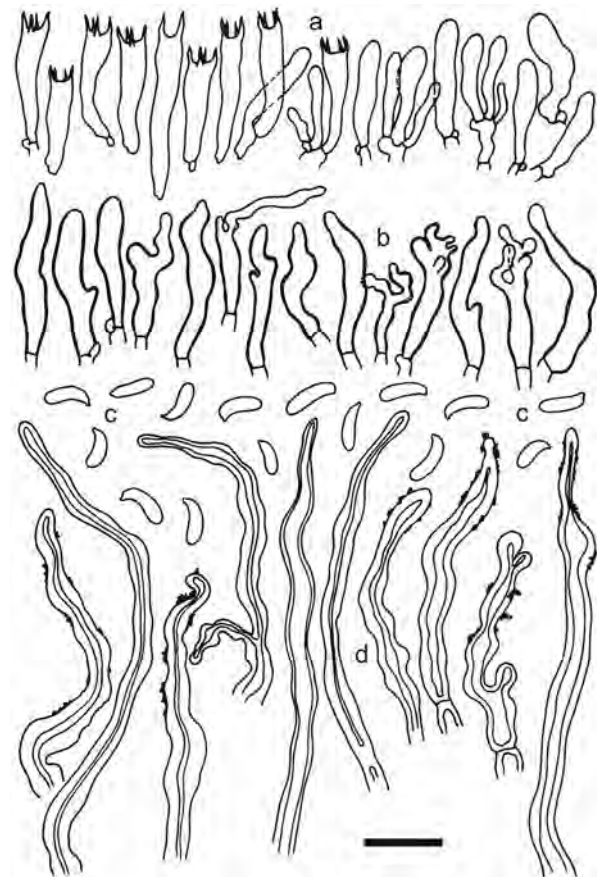


Fig. 2. *Panellus ringens*: a – basidia and basidioles, b – cheilocystidia, c – spores, d – terminal cells in the pileipellis (Stolické vrchy Mts, 25 March 2006, SLO 787). Scale bar = 10 µm for spores, 15 µm for other structure.

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Basidiomata in groups, growing out from the substrate separately or in clusters of 2–8 (10) basidiomata. Stipe absent, basidiomata attached to the substrate dorsally or laterally (by stem-like base). Pileus (3) 5–10 (20) mm, irregularly circular, flabelliform, rounded flabelliform, spatuliform or reniform (from above), hemispherical convex to plano-convex (from aside), hygrophanous; margin involute, with age inflexed to straight (aspect), crenulated, sometimes lobed (shape), translucently striate (distinctly when wet); surface whitish granulose-fibrillose to tomentose (fibrils and hairs equally all over the surface or somewhat denser towards the point of attachment and margin; in some cases almost invisible when wet, but distinct when dry), background red brown to brown (usually darker towards the point of attachment), occasionally with violet shades when young. Trama up to 1 mm thick, off-white, taste indistinct or somewhat bitter, smell indistinct. Lamellae $L = 11\text{--}17$, $l = 3, 5$ or 7 , with wide $0.5\text{--}1$ mm, radiating from central to eccentric spot or from lateral stem-like base, ventricose, adnexed, light brown, brown, red brown, sometimes with pink hue, edge even, concolorous or darker.

Spores cylindrical, narrowly cylindrical, allantoid, (5) $5.9\text{--}7.3$ (8) \times (1.5) $1.7\text{--}2$ μm , av. 6.6×1.8 μm , $Q = (2.8) 3.2\text{--}4$ (4.7), av. $Q = 3.6$, smooth, colourless and amyloid. Basidia 4-spored, rarely 2-spored, clavate, narrowly clavate, (15) $17\text{--}23.4$ (33) \times $4\text{--}5$ (6.5) μm , av. 20.2×4.5 μm , colourless to yellowish, thin-walled. Basidioles clavate, narrowly clavate, narrowly cylindrical, (12) $14.9\text{--}22.7$ (33) \times (2.5) $3.1\text{--}4.6$ (5.5) μm , av. 18.8×3.8 μm , colourless to yellowish, thin-walled. Cheilocystidia clavate, narrowly clavate, narrowly cylindrical, narrowly fusiform, narrowly utriform, flexuous, some with lateral outgrowth or with branching uppermost part, (16) $21.1\text{--}32.7$ (42) \times (2) $3.9\text{--}6.3$ (7.5) μm , av. 26.9×5.1 μm , colourless to yellowish, thick-walled or thin-walled, in one mount embedded in yellowish mucus. Subhymenium $10\text{--}18$ μm deep, of dense, intricate, irregularly oriented, $1.5\text{--}3.5$ μm wide hyphae, well delimited from trama. Trama in lamellae composed of parallel to sub-parallel, thick-walled hyphae, $3.5\text{--}7$ (10) μm wide, with wall thickness $1\text{--}3$ μm , occasionally branched and anastomosed, colourless, in clamp-connections with circular hole up to 5 μm wide. Pileipellis an intricate trichoderm, the erect hyphae (arising from decumbent hyphae) thick-walled, $5\text{--}11$ μm wide, with wall thickness $0.5\text{--}3$ μm , flexuous to twisted, some nodulose, tapering towards the end, often intricate, but not fascicled, branched, mostly incrustated. Trama in pileus similar to lamellar trama. Gelatinous matrix inconspicuous. In some mounts, yellowish crystals about $2\text{--}15$ μm in diam. were observed in all tissues. Clamp connections present.

Panellus violaceofulvus (Batsch) Singer, Beih. Botan. Centralbl., Abt. B 56: 142 (1936)

Description (Figs 3, 4)



Fig. 3. *Panellus violaceofulvus*: basidiomata (Kremnické vrchy Mts, 16 February 2013, PVKU 884). Photo V. Kunca.

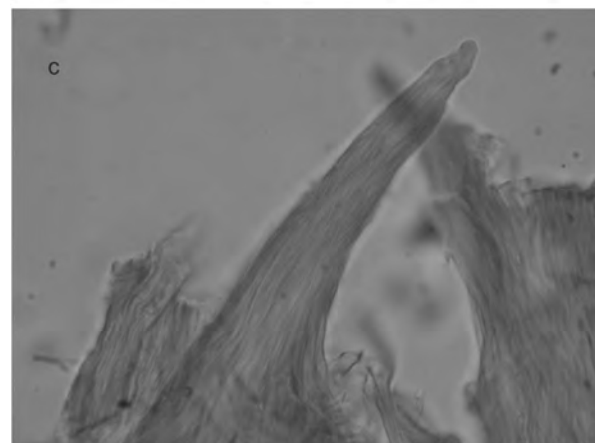
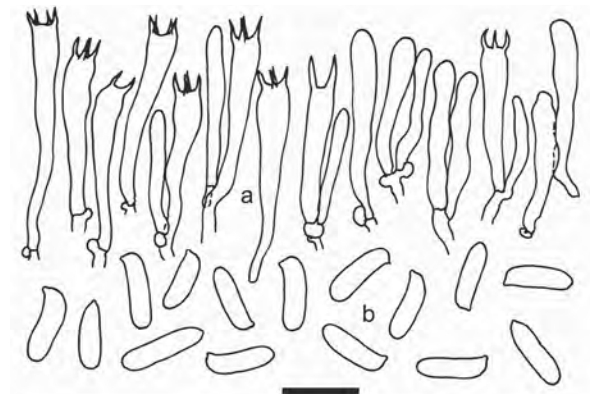


Fig. 4. *Panellus violaceofulvus*: a – basidia and basidioles, b – spores, c – terminal cells in the pileipellis (conical structure) (Javorníky Mts, 1 April 2009, SAV 10487). Scale bar = 10 μm for spores, 15 μm for basidia and basidioles, 20 μm for conical structure. Del. and photo S. Jančovičová.

Basidiomata in groups, growing out from the substrate in clusters of 2–12 basidiomata or separately. Stipe absent, basidiomata attached to the substrate laterally (by stem-like base) or dorsally. Pileus 5–30 mm, irregularly circular, flabelliform, rounded flabelliform or reniform (from above), hemispherical convex to plano-convex (from aside), hygrophanous; margin involute, with age inflexed, straight to reflexed (aspect), crenulated, sometimes lobed (shape), translucently striate (distinctly when wet); surface whitish granulose-fibrillose, tomentose to strigose (fibrils and hairs denser towards the point of attachment, distinct when dry), background red brown, violet brown to black violet. Trama up to 1.5 mm thick, off-white, taste bitter, smell indistinct. Lamellae L = 11–20, l = 3, 5 or 7, with wide 0.5–1.5 mm, radiating from lateral stem-like base or from central to eccentric spot, ventricose, adnexed, light violet, light brown, violet brown, red brown, often with pink hue, edge even, concolorous, lighter or darker.

Spores cylindrical, (6.5) 7.8–10.2 (11.5) × (2.5) 2.8–3.2 (3.5) μm, av. 9 × 3 μm, Q = (2) 2.6–3.2 (3.3), av. Q = 2.9, smooth, colourless and amyloid. Basidia 4-spored, rarely 2-spored, narrowly clavate, (25) 29.4–37.2 (43) × (4.5) 5.2–6.5 (7.5) μm, av. 33.4 × 5.9 μm, colourless, thin-walled. Basidioles narrowly clavate, narrowly cylindrical, (19) 23.5–34.2 (45) × (2.8) 3.3–5.4 (7) μm, av. 28.9 × 4.3 μm, colourless, thin-walled. Cheilocystidia not observed. Subhymenium 16–23 μm deep, of dense, intricate, irregularly oriented, 2–3.5 μm wide hyphae, well delimited from trama. Trama in lamellae composed of parallel to sub-parallel, thick-walled hyphae, 3–8 μm wide, with wall thickness 0.5–1.5 (2) μm, occasionally branched and anastomosed, colourless, in clamp-connections circular hole up to 1.5 μm wide. Pileipellis a transition between cutis and (ixo) trichoderm; a cutis layer consists of ± repent hyphae (some of them branching and anastomosing), thick-walled, 3–6 μm wide, with wall thickness 0.5–1 μm, straight to flexuous, with distance between septa more than 100 μm; the erect hyphae stand either ± individually or are fused together and form some conical (pyramidal) structures (these hyphae are unbranched, at the apex tapered and thin-walled); length and quantity of hyphae forming such cones differ (the highest observed conus measured 210 μm). In some mounts, conical structures embedded in the gelatinous matrix. Trama in pileus similar to lamellar trama. Clamp connections present.

Specimens studied

***Panellus ringens*:** Muránska planina Plateau, SE of the village Telgárt, locality “Za Skalickou”, 48°50'16.7"N", 20°12'7.36"E, 1,015 m asl, mire willow scrub dominated by *Salix cinerea*, on bark of fallen decaying branch of *Salix cinerea*, c. 0.5 cm in diam., 18 November 2003, leg. D. Blanár (SLO 790). – Ibidem, on bark of fallen decaying branch of *Salix pentandra*, c. 1 cm in diam., 18 November 2003, leg. D. Blanár (SLO 791). – Stolické vrchy Mts, c. 1.5 km ENE of the city Tisovec, near the Šťavica spring, alluvium of the Skalička

Stream, 48°41'11.28"N, 19°57'47.23"E, c. 460 m asl, stand with *Salix*, *Alnus* and *Fraxinus*, on bark of fallen decaying branch of *Salix* sp., 1–2 cm in diam., 25 March 2006, leg. S. Jančovičová (SLO 787); published by RÍPKOVÁ et al. (2007) as *Panellus violaceofulvus*. – NNE of the village Muránska Zdychava, saddle “Šumiacka priehyba”, 48°47'38.37"N, 20°10'24.14"E, 1,170 m asl, species rich *Nardus* grassland (*Nardo-Agrostion tenuis*), on bark of branch growing from the standing trunk of *Salix caprea*, c. 2 cm in diam., 17 January 2009, leg. D. Blanár (SLO 788). – About 2.6 km N of the village Muránska Zdychava, alluvium of the Zdychavka (Zdychava) Stream, 48°45'40.36"N, 20°8'37.24"E, 658 m asl, submontane riparian mixed forest with *Picea abies* and *Alnus incana*, less *Salix fragilis*, *S. purpurea*, *Corylus avellana* a. o., on bark of branch growing from the standing trunk of *Salix caprea*, c. 1 cm in diam., 21 September 2012, leg. S. Jančovičová (SLO 1427, PVKU 747). – About 800 m SW of the village Dobrý Potok, 48°32'58.19"N, 19°40'41.94"E, 395 m asl, mixed stream bank forest with *Salix* sp., *Alnus glutinosa* and *Corylus avellana*, on bark of decaying branches of *Salix* sp., fallen on ground or tangled among other trunks, c. 1.5 cm in diam., 4 January 2014, leg. M. Smiková (PVKU 1140). – About 2.5 km NW of the city Revúca, 48°41'59.99"N, 20°5'51.67"E, 330 m asl, remnant of submontane mixed riparian forest with dominance of *Alnus glutinosa*, on bark of standing decaying trunk of *Padus avium*, c. 8 cm in diam., 25 October 2015, leg. V. Kunca (PVKU 1564).

– Revúcka vrchovina Mts, city Revúca, conflux of the Zdychavka (Zdychava) Stream and the Muránka (Muráň) River, alluvium, 48°40'47.44"N, 20°6'30.52"E, 310 m asl, willow stand with *Salix fragilis* (*Salicion albae*), on bark of standing thin trunk of *Salix cinerea*, 2–3 cm in diam., 20 November 2010, leg. D. Blanár (SLO 984); published by MIHÁL and BLANÁR (2014) as *Panellus* cf. *ringens*.

– Liptovská kotlina Basin, 1.3 km NE of the village Žiar, 49°8'8.01"N, 19°41'13.15"E, 845 m asl, mixed stream bank forest, on bark of standing decaying thin trunk of *Salix* sp., 11 November 2013, leg. M. Paulíny (PVKU 1117); referred by PEIGER et al. (2015). – NE of the village Pavčina Lehota, c. 50 m W of the Nature Reserve Jelšie, 49°2'24.07"N, 19°33'51.06"E, 670 m asl, mixed stream bank forest with dominance of *Salix* sp. and *Alnus glutinosa*, on bark of broken decaying thin branch of *Salix* sp. with one end touching the ground, 5 January 2014, leg. P. Tomka (PSG 5341); referred by PEIGER et al. (2015).

– Popradská kotlina Basin, c. 1 km SW of the village Gánovce, 49°1'22.09"N, 20°18'57.81"E, 660 m asl, intensively managed open remnant of submontane riparian forest with dominance of *Salix* sp., on bark of broken decaying branch of *Salix* sp. (in vertical position), c. 1.5 cm in diam., 22 February 2016, leg. M. Ondo (PVKU 1606).

– Horehronské podolie Basin, village Tále, 2 km SSW of the hotel Stupka, 48°51'55.62"N, 19°35'28.47"E, 676

m asl, old and sparse, not intensively managed forest of *Picea abies* and *Abies alba* with admixed *Corylus avellana*, *Populus tremula* and *Salix* sp., on bark of decaying branches of uprooted *Salix* sp., branches c. 1 m above the ground, c. 6 cm in diam., 23 January 2014, leg. R. Rutkowski (PSG 5377).

– Zvolenská kotlina Basin, c. 1.5 km S of the village Zolná, 48°35'11.05"N, 19°13'31.55"E, 345 m asl., remnant of submontane mixed riparian forest with dominance of *Salix* sp., on bark of decaying branch of *Salix* sp. tangled among tree-branches, c. 2 cm in diam., 4 December 2015, leg. V. Kunca (PVKU 1585).

Panellus violaceofulvus: Veporské vrchy Mts, c. 7 km SSE of the village Čierny Balog, National Nature Reserve Dobročský prales, 48°40'48.26"N, 19°40'19.14"E, 870 m asl, on bark of fallen decaying branch of *Picea abies*, c. 1 cm in diam., 17 November 2003, leg. V. Kučera (SLO 789). – Central part of the National Nature Reserve Dobročský prales, 48°40'54.31"N, 19°40'48.12"E, c. 935 m asl, old-growth forest with *Fagus sylvatica*, *Abies alba* and *Picea abies*, on bark of fallen decaying branches of *Abies alba*, 3–4 cm in diam., 28 May 2010, leg. S. Glejdura, V. Kunca (PVKU 244, PSG 3684). – Village Čierny Balog, near the train station Svätý Ján, 48°46'50.36"N, 19°35'34.31" E, 530 m asl, managed forest with *Abies alba* and *Picea abies*, on bark of fallen decaying branch of *Abies alba*, c. 3 cm in diam., 17 April 2013, leg. M. Peiger (PVKU 915).

– Stolické vrchy Mts, village Muránska Zdychava, settlement Števkov diel, 48°45'34.8"N, 20°9'27.8"E, 824 m asl, managed forest with *Fagus sylvatica*, *Picea abies* and *Abies alba*, on bark of fallen thin branch of *A. alba*, 9 November 2013, leg. S. Glejdura (PSG 5195). – About 2.2 km NW of the village Šoltýska, ski and recreation resort Kokava-Háj, 48°35'36.29"N, 19°43'23.31"E, 780 m asl, managed forest with *Picea abies*, *Abies alba* and *Fagus sylvatica*, on bark of fallen decaying branch of *Abies alba*, c. 5 cm in diam., 9 January 2014, leg. P. Smik (PVKU 1144).

– Starohorské vrchy Mts, c. 900 m NNE of the church in the village Staré Hory, 48°50'36.33"N, 19°7'15.05"E, 640 m asl, managed special purpose forest with *Fagus sylvatica*, *Abies alba* and *Picea abies*, on unbarked wood of fallen decaying branch of *Abies alba*, c. 3 cm in diam., 28 November 2006, leg. S. Glejdura (PSG 3011). – About 1.2 km NE of the church in the village Staré Hory, 48°50'47.21"N, 19°7'45.94"E, c. 670 m asl, on bark of fallen decaying branches of *Abies alba* and *Picea abies*, 3–5 cm in diam., 11 December 2009, leg. S. Glejdura, V. Kunca (PVKU 184, PSG 1253); published (with wrong data) by Hagara (2014). – Village Uľanka, near the train station Uľanka, 48°47'44.32"N, 19°6'12.92"E, 485 m asl, protective forest with *Picea abies* and *Abies alba*, on bark of fallen decaying branches of *Abies alba*, 2.5–3 cm in diam., 14 May 2013, leg. V. Kunca (PVKU 960). – About 0.2 km E of the church in the village Staré Hory, 48°50'2.46"N,

19°7'0.37" E, 520 m asl, managed forest with *Abies alba* and *Picea abies*, on bark of fallen decaying branches of *Abies alba*, c. 3 cm in diam., 23 October 2015, leg. V. Kunca (PVKU 1560).

– Západné Tatry Mts, right ridge of the Žiarska dolina valley, 1,123 m asl, managed forest with *Picea abies* and *Pinus sylvestris*, on bark of stump of *Picea abies*, c. 25 cm in diam., 4 October 2012, leg. M. Peiger, V. Kunca (PVKU 770); referred by PEIGER et al. (2015).

– Vysoké Tatry Mts, village Podbanské, Kamenistá dolina valley, c. 1 km NW of the hotel Kriváň, 49°08'57.25"N, 19°53'14.79"E, c. 1,050 m asl, *Picea abies* forest with admixed *Abies alba* a. o., on bark of fallen decaying trunk of cf. *Abies alba*, 24 October 2012, leg. S. Jančovičová (SLO 1449).

– Nízke Tatry Mts, c. 400 m W of the village Malužiná, 48°58'48.63"N, 19°45'38.11"E, 850 m asl, protective forest with *Picea abies* and *Abies alba*, on wood (unbarked part) of fallen decaying trunk of *Abies alba*, 70–80 cm in diam., 4 September 2013, leg. M. Paulíny (PVKU 1009); referred by PEIGER et al. (2015).

– About 80 m E of the village Jarabá, 48°53'20.86"N, 19°41'24.98"E, 895 m asl, managed forest with *Picea abies*, *Abies alba* and *Fagus sylvatica*, on bark of fallen decaying branch of *Abies alba*, c. 1 cm in diam., 9 March 2016, leg. V. Kunca (PVKU 1613).

– Kremnické vrchy Mts, c. 2 km NW of the spa in the village Kováčová, 48°37'16.81"N, 19°4'34.06" E, c. 360 m asl, managed special purpose forest with *Abies alba*, *Picea abies* and *Fagus sylvatica*, on bark of tree-top of fallen decaying young trunk of *Abies alba*, c. 3 cm in diam., 16 April 2010, leg. S. Glejdura, V. Kunca (PVKU 219). – Ibidem, on bark of fallen decaying branch of *Abies alba*, c. 4 cm in diam., 26 November 2010, leg. V. Kunca (PVKU 435). – Ibidem, on bark of fallen decaying branch and on bark of tree-top of fallen decaying young trunk of *Abies alba*, 3–5 cm in diam., 21 December 2011, leg. V. Kunca (PVKU 592).

– About 1.8 km NW of the spa in the village Kováčová, 48°37'0.88"N, 19°4'42.25"E, c. 350 m asl, managed special purpose forest with *Abies alba*, *Picea abies* and *Fagus sylvatica*, on bark of fallen decaying branch of *Abies alba*, c. 4 cm in diam., 15 July 2012, leg. V. Kunca (PVKU 701). – About 1.4 km NW of the church in the village Budča, 48°35'5.12"N, 19°3'5.09"E, c. 410 m asl, managed special purpose forest with *Fagus sylvatica* and *Abies alba*, on bark of cut decaying branches of *Abies alba*, 2–4 cm in diam., 10 November 2012, leg. V. Kunca (PVKU 855). – About 2 km NW of the church in the village Sielnica, 48°38'47.68"N, 19°5'4.51"E, 460 m asl, managed forest with *Abies alba* and *Picea abies*, on bark of cut decaying branches of *Abies alba*, 3–4 cm in diam., 16 February 2013, leg. V. Kunca (PVKU 884). – Village Kováčová, valley of Kováčovský potok Stream, 1.5 km NE of Stará Kováčová Hill, 48°37'18.9"N, 19°4'33.4"E, 379 m asl, managed special purpose forest with *Abies alba*, *Picea abies* and *Fagus sylvatica*, on bark of fallen trunk of *Abies alba*, 17 cm in diam., 7 April 2013, leg.

S. Glejdura (PSG 5194). – Village Ihráč, right slope of valley of the Vápenný potok Stream, 48°39'42.4"N, 18°58'37"E, 716 m asl, old-growth forest Dolný Chlm, on bark of fallen decaying branch of *Abies alba*, c. 4 cm in diam., 14 November 2013, leg. S. Glejdura (PSG 5170). – About 2 km NW of the spa in the village Kováčová, 48°37'32.33"N, 19°4'37.92"E, c. 395 m asl, managed special purpose forest with *Fagus sylvatica*, *Quercus petraea* and *Abies alba*, on bark of fallen decaying branch of *Abies alba*, c. 3 cm in diam., 22 February 2015, leg. V. Kunca (PVKU 1371). – About 7 km NW of the village Sielnica, 48°40'3.61"N, 19°2'56.88"E, 590 m asl, managed forest with *Abies alba*, on bark of fallen decaying branch of *Abies alba*, 2–3 cm in diam., 1 March 2015, leg. V. Kunca (PVKU 1372). – Village Badín, beyond the border of the NW part of the National Nature Reserve Badínsky prales, 48°40'3.61"N, 19°2'56.88" E, c. 770 m asl, natural forest with *Fagus sylvatica* and *Abies alba*, on bark of fallen decaying branch of *Abies alba*, c. 4 cm in diam., 11 March 2015, leg. R. Rutkowski (PVKU 1379). – Poľana Mts, city Hriňová, settlement Snohy, E part of the National Nature Reserve Zadná Poľana, 48°38'42.72"N, 19°30'21.18"E, 1,086 m asl, old-growth forest with *Fagus sylvatica*, *Abies alba* and *Acer pseudoplatanus*, on bark of fallen decaying branches of *Abies alba*, 2–3 cm in diam., 18 September 2013, leg. V. Kunca, S. Glejdura (PVKU 1019, PSG 5184). – Javorie Mts, city Zvolen, c. 1.3 km S of the Môt'ová water reservoir, 48°32'20.36"N, 19°10'32.21"E, 465 m asl, managed special purpose forest with *Quercus petraea*, *Abies alba* and *Fagus sylvatica*, on bark of tree-top of fallen decaying young trunk of *Abies alba*, c. 3 cm in diam., 8 March 2013, leg. V. Kunca (PVKU 891). – About 1 km NEE of the village Ostrá Lúka, 48°33'5.73"N, 19°4'30.74"E, 400 m asl, protective forest with dominance *Abies alba*, on bark of fallen decaying branch of *Abies alba*, c. 3 cm in diam., 17 March 2013, leg. V. Kunca (PVKU 893). – Zvolenská kotlina Basin, c. 1 km SEE of the village Dúbravica, 48°40'21.95"N, 19°17'15.88"E, 600 m asl, managed forest with *Fagus sylvatica*, *Picea abies* and *Abies alba*, on bark of tree-top of fallen decaying young trunk of *Abies alba*, on small unbarked area between bark and wood, c. 4 cm in diam., 22 November 2013, leg. V. Kunca (PVKU 1123). – About 2.5 km NW of the village Poniky, 48°43'25.72"N, 19°15'20.55"E, 610 m asl, managed forest with *Fagus sylvatica*, *Abies alba* and *Picea abies*, on bark of fallen decaying branch of *Abies alba*, c. 3 cm in diam., 5 May 2015, leg. V. Kunca (PVKU 1411). – Javorníky Mts, c. 7.5 km NW of the church in the village Papradno, settlement Badačov grúnik (also known as settlement Macháčovce), 49°16'37.91"N, 18°20'12.44"E, 748 m asl, forested area dominated by *Fagus sylvatica* and *Acer* spp., with admixed *Abies alba*, *Larix decidua*, *Pseudotsuga menziesii* a. o., on bark of fallen decaying trunk of *Pseudotsuga menziesii*, 1 April

2009, leg. V. Kučera (SAV 10487). – Village Dešná, c. 500 m NNW of the village part Beňadín, 49°14'6.79"N, 18°9'39.47"E, 580 m asl, managed forest with *Picea abies* and *Abies alba*, on bark of fallen decaying branch of *Abies alba*, c. 3 cm in diam., 3 January 2014, leg. V. Pšenka (PVKU 1139). – About 1 km SSW of the village Vysoká nad Kysucou, 49°22'0.46"N, 18°32'2.79"E, 655 m asl, managed forest with *Picea abies* and *Abies alba*, on bark of fallen decaying branch of *Abies alba*, 8–10 cm in diam., 21 February 2014, leg. M. Zajac (PVKU 1168).

– Podbeskydská brázda Furrow, village Oravská Polhora, 500 m E of the settlement Slaná Voda, 49°31'19.2"N, 19°28'54.7"E, 744 m asl, juvenile managed forest with *Picea abies* and *Abies alba*, on bark of fallen decaying branch of *A. alba*, 13 January 2014, leg. R. Rutkowski (PSG 5342).

– Bukovské vrchy Mts, village Osadné, National Nature Reserve Udava, 49°10'44.34"N, 22°12'59.71"E, 640 m asl, old-growth forest with *Fagus sylvatica* and *Abies alba*, on bark of fallen decaying thin branches of *Abies alba*, 13 April 2013, leg. J. Pavlík (PVKU 907).

– Laborecká vrchovina Mts, village Nižný Komárnik, National Nature Reserve Komárnická jedlina, 49°22'53.63"N, 21°44'47.68"E, 510 m asl, old-growth forest with *Fagus sylvatica*, *Abies alba* and *Ulmus glabra*, on bark of fallen decaying branch of *Abies alba*, c. 2 cm in diam., 9 March 2016, leg. V. Kunca (PVKU 1610).

***Phyllotopsis nidulans*:** Nízke Tatry Mts, village Malužiná, at the bank of the Boca River near the mouth of Skribňovo valley, 730 m asl, on dead stump of *Salix alba*, 16 April 2006, leg. V. Kautman (BRA CR 8435); published by Kautmanová (2006) and Hagara (2014) as *Panellus ringens*. – Ibidem, on bark of fallen decaying branch of *Salix alba*, c. 10 cm in diam., 27 April 2011, leg. V. Kučera (SLO 828).

Published records from Slovakia

Two first collections of *Panellus ringens* from Slovakia are those from 1972 kept in the herbarium PRM (one from Levočské vrchy Mts, and the second one from Lubovnianska vrchovina Mts). They were published by ŠKUBLA (2003) and KAUTMANOVÁ (2006). The third record of *P. ringens*, namely the collection from 2006, Nízke Tatry Mts, was published by KAUTMANOVÁ (2006). This collection [regarded as *P. ringens* also by HAGARA (2014)], however, represents *Phyllotopsis nidulans* (= BRA CR 8435 in the Specimens studied). Since then, many other collections of *P. ringens* have been recorded (see Specimens studied), but only a few published: RIPKOVÁ et al. (2007) published one collection from 2006, Stolické vrchy Mts (= SLO 787, incorrectly identified as *Panellus violaceofulvus*); MIHÁL and BLANÁR (2014) published one collection from 2010, Revúcka vrchovina Mts (= SLO 984 as *P. cf. ringens*); and PEIGER et al. (2015) referred to four collections from 2012–2015,

Liptovská kotlina Basin (two of them = PVKU 1117 and PSG 5341). Altogether, we have found out eight published collections of *P. ringens* from Slovakia.

RIPKOVÁ et al. (2007) published 17 collections of *Panellus violaceofulvus* from Slovakia, concerning also data by KUTHAN (1989), KUTHAN et al. (1999), ŠKUBLA (2003) and ADAMČÍK et al. (2007). The latest of these collections from 2006, Stolické vrchy Mts has been re-identified as *P. ringens* in this study (= SLO 787). The rest of these *P. violaceofulvus* collections are from the years 1914–2003, kept in the herbaria BRA, PRM, GENT and private herbarium of J. Heilmann-Clausen; one collection is from Oravská vrchovina Mts, Malá Fatra Mts, Štiavnické vrchy Mts, and Liptovská kotlina Basin, two from Nízke Tatry Mts and Levočské vrchy Mts, three from Laborecká vrchovina Mts and five from Bukovské vrchy Mts. Number of *P. violaceofulvus* records has almost tripled since then, but only a few of them were published: MIHÁL et al. (2011) published one collection from 2008, Stolické vrchy Mts (this collection from *Salix caprea* could represent *P. ringens*; however, the specimen does not exist and we have not counted it); HAGARA (2014) published one collection from 2006, Starohorské vrchy Mts (= PVKU 184); and PEIGER et al. (2015) referred to one collection from 2012, Západné Tatry Mts (= PVKU 770) and one from 2013, Nízke Tatry Mts (= PVKU 1009). Altogether, we have found out 21 collections of *P. violaceofulvus* published from Slovakia up to this time.

Species differentiation based on the morphological characters observed on the Slovak collections

Observing Slovak collections of *Panellus ringens* and *P. violaceofulvus*, we have found out differences in their macro- and micromorphological characters.

Macroscopically, both species are very similar. In our material, basidiomata of *P. ringens* are somewhat smaller (max. size 20 mm in diam.) than of *P. violaceofulvus* (max. size 30 mm in diam.). In colour of pileus, red-brown dominate in *P. ringens* and violet-brown in *P. violaceofulvus*, but shades of both colours could be seen in *P. ringens* as well *P. violaceofulvus*. Especially when dry, surface of both species is distinctly hairy, but the hairs are usually somewhat thicker and longer in *P. violaceofulvus* (especially at the point of attachment). Despite of some differences, we do not treat macroscopic features as determining (Figs 1, 3).

Microscopically, both species distinctly differ in their spores characters. While *P. ringens* has spores cylindrical, narrowly cylindrical and allantoid, av. $6.6 \times 1.8 \mu\text{m}$, av. $Q = 3.6$, *P. violaceofulvus* cylindrical, av. $9 \times 3 \mu\text{m}$, av. $Q = 2.9$. In hymenium of *P. ringens*, we have observed cheilocystidia of various shapes, thick-walled or thin-walled, with av. $26.9 \times 5.1 \mu\text{m}$; such cystidia, according to our observations absent in *P. violaceofulvus*. Basidia also seem to be of taxonomic importance: basidia of *P. ringens* with av. 20.2×4.5

μm are distinctly smaller comparing with those of *P. violaceofulvus* with av. $33.4 \times 5.9 \mu\text{m}$. Pileipellis of both species is also different: in *P. ringens*, the erect hyphae are thick-walled, 5–11 μm wide, with wall thickness 0.5–3 μm , flexuous to twisted, some nodulose, often intricate, but not fascicled, mostly incrustated; while in *P. violaceofulvus*, the erect hyphae are thick-walled, 3–6 μm wide, with wall thickness 0.5–1 μm , flexuous, standing either \pm separately, or fused together to form some conical structures. The differences are also in trama: tramal hyphae of pileus and lamellae in *P. ringens* are 3.5–7 (10) μm wide, with wall thickness 1–3 μm , in clamp-connections with circular hole up to 5 μm wide; in *P. violaceofulvus*, they are 3–8 μm wide, with wall thickness 0.5–1.5 (2) μm , in clamp-connections with circular hole up to 1.5 μm wide (Figs 2, 4).

Species differentiation based on the morphological characters used in the literature

In literature, *Panellus ringens* and *P. violaceofulvus* are distinguished using various characters. We have compared our observations and measurements with those in the selected literature. It is the literature in which both studied species are included and which is/ was traditionally used to identify fungal taxa: MOSER (1983), PÖDER (1985), WAILING and GREGORY (1989), BREITENBACH and KRÄNZLIN (1991), KÄÄRIK (1992) and VESTERHOLT (2012) (Table 1).

Out of macroscopic characters, colour and size of pileus are mostly compared. No author described violet colour in *P. ringens* and PÖDER (1985) even stressed that this colour never occurred in this species. As to pileus size, the authors described *P. violaceofulvus* to be smaller or of similar size as *P. ringens*. However, it contradicts our observations.

Most authors used size of spores as the first character in the key. We also agree that spores characters are of high taxonomic importance. Spores of *P. ringens* and *P. violaceofulvus* do not overlap in their width and only minimally in their length. Our measured values of spore length are somewhat higher, but we think it is consistent with the delimitation and variability of both species.

Cheilocystidia are controversial. Some authors described them in *P. ringens*, some other, contrary, in *P. violaceofulvus*. We are not able to explain this conflict, as we have observed cheilocystidia only in material of *P. ringens*.

To distinguish *P. ringens* from *P. violaceofulvus*, MOSER (1983) and KÄÄRIK (1992) used subhymenium characters. Without any specification, these authors stated that subhymenium was well developed in *P. ringens* in comparison to poorly developed subhymenium in *P. violaceofulvus*. PÖDER (1985) described subhymenium in *P. ringens* as \pm well differentiated, in *P. violaceofulvus* \pm slender, gelatinous. According to our observations, subhymenium is well delimited from

Table 1. The comparison of the characters used to differentiate *Panellus ringens* and *P. violaceofulvus* in the selected literature and our own observations

	<i>Panellus ringens</i>	<i>Panellus violaceofulvus</i>
Pileus size (mm) and colour		
Our observations	3–20, red brown to brown (occasionally with violet shades when young)	5–30, red brown, violet brown to black violet
MOSER (1983)	5–25, brownish red, flesh brownish	5–15, violet brown, violet
PÖDER (1985)	5–15, red flesh red, red brown (without any violet shades)	5–15, violet purple, black violet, yellow ochre shades towards base
WATLING and GREGORY (1989)	7.5–25, light purple, purple drab, vinaceous, vinaceous grey, vinaceous buff, clay pink	–, similar colours as <i>P. ringens</i>
BREITENBACH and KRÄNZLIN (1991)	–, flesh brownish	8–25, black violet, brown violet
KÄÄRIK (1992)	5–25, flesh	5–15, vinaceous purple, violet
VESTERHOLT (2012)	5–30, purplish brown, vinaceous	5–15, violet to purple, purplish brown
Spores (µm)		
Our observations	5–8 × 1.5–2	6.5–11.5 × 2.5–3.5
MOSER (1983)	4–6 × 1.5–2	6–10 × 2–4
PÖDER (1985)	4–5 × 1.5–2	6–10 × 2.5–3
WATLING and GREGORY (1989)	4–7 × 1.2–2	6.5–10 × 2.2–3.5
BREITENBACH and KRÄNZLIN (1991)	4.5–6 × 1.5–2	6.5–9.5 × 2.6–4.2
KÄÄRIK (1992)	4–6 × 1.5–2	6–10 × 2–4
VESTERHOLT (2012)	5–7 × 1–2	6.5–9.5 × 2.5–3.5
Cheilocystidia (µm)		
Our observations	16–42 × 2–7.5, clavate, narrowly (n.) clavate, n. cylindrical, n. fusiform, n. utriform, flexuous, some nodulose or branched	not observed
PÖDER (1985)	absent	± basidium like, rarely with short diverticules
WATLING and GREGORY (1989)	25–40 × 4.2–5.5, clavate, cylindrical, fusiform	–
BREITENBACH and KRÄNZLIN (1991)	–	22–35 × 3–4, fusiform, flexuous, sometimes with short outgrowths
KÄÄRIK (1992)	rare, hyphoid	–
VESTERHOLT (2012)	absent or inconspicuous	22–35 × 3–5 cylindrical to subclavate, sometimes irregular with lateral outgrowths
Subhymenium		
Our observations	10–18 µm deep, of dense, intricate, irregularly oriented, 1.5–3.5 µm wide hyphae	16–23 µm deep, of dense, intricate, irregularly oriented, 2–3.5 µm wide hyphae
PÖDER (1985)	± well differentiated	± slender, gelatinous
MOSER (1983)	clearly differentiated from cap flesh (dense)	hyphae in subhymenium and in trama swollen-gelatinous, in subhymenium somewhat thinner
KÄÄRIK (1992)	well developed	poorly developed

Size of structures in our observation is given as minimum and maximum. –, character not mentioned. If the authors are not listed, they did not describe the character.

trama in both species and differs minimally: it is 10–18 µm deep and formed of 1.5–3.5 µm wide hyphae in *P. ringens* and 16–23 µm deep and composed of 2–3.5 µm wide hyphae in *P. violaceofulvus*.

With exception of PÖDER (1985), the authors described the pileipellis briefly or not at all. According to PÖDER (1985), pileipellis of *P. ringens* consists of thick-walled, 4–6 (7) μm wide hyphae, originating from a layer of radially laying, pigmented, gelatinous, and 3–4 μm wide hyphae. In *P. violaceofulvus*, pileipellis is a trichoderm, formed of thick-walled, often irregularly flexuous, branched, 3–4 μm wide hyphae, arising from radially deposited, gelatinous hyphae. Following descriptions by PÖDER (1985), differences between *P. ringens* and *P. violaceofulvus* are a little bit ambiguous. We consider the pileipellis characters to be determining.

Tramal characters seem to be also important. Out of all compared works, it was only PÖDER (1985) who described trama more detailed. According to him (PÖDER, 1985), trama in pileus of *P. ringens* consists of thick-walled, 3–6 μm wide hyphae, often with intercalary or apical inflations up to 30 μm wide (called sclerocystidia in the legend to the figure); trama in lamellae consists of 3–4 μm wide hyphae. In *P. violaceofulvus*, PÖDER (1985) described hyphae of trama in pileus as thick-walled, 3 μm wide, with intercalary or apical inflations up to 28 μm wide (sclerocystidia); hyphae of trama in lamellae as thick-walled, 3–5 μm wide. We have not observed such sclerocystidia in our material, but the differences in wall thickness of hyphae and width of hole in clamp-connections are evident.

Ecology, occurrence and threat in Slovakia

In this study, we have gathered information about 17 collections of *Panellus ringens* (eight published and nine new, i.e. introduced in this paper) and 53 of *P. violaceofulvus* (21 published and 33 new) collected in Slovakia. Based on these collections, the species have different ecological requirements: *P. ringens* prefers hardwoods, *P. violaceofulvus* conifers.

Panellus ringens was recorded on willow trees and bushes, such as *Salix caprea*, *S. cinerea*, *S. pentandra* and *S. sp.*; only once on *Padus avium*. Basidiomata were produced on bark of branches and trunks. Branches of 0.5–6 cm in diam. were a) laying on the ground, b) broken and touching the ground only with some part or c) without any contact with the ground, i.e. growing from the standing trunks, from the uprooted trunks or broken and tangled among tree-branches or other trunks. The trunks of 2–8 cm in diam. were standing, still living or dead. The collections are from September to March. We think that the basidiomata production in winter to early spring could be a reason why some collections were sterile (without matured spores).

The most collecting sites of *P. ringens* had wetland character – they were the stands along streams and rivers where *Salix* species were dominant or admixed, i.e. the stands with *S. fragilis* and/or other willows; as altitude increase, they were the stands with *Alnus glutinosa* and *Fraxinus excelsior*; then the stands with *Alnus incana* and *Picea abies*; the scrub with dominant *Salix cinerea*;

and the species rich *Nardus* grassland. One collection was from the *Picea abies* forest with admixed *Abies alba*. The majority of stands belong to the agricultural land resources and it means that trunks having a tree girth up to 40 cm (such like trees are present almost in all collecting sites) can be cut at any time (without any administrative permission) (Act of NC SR No. 543/2002 on Nature and Landscape Protection). The altitude of the collecting sites ranges from 310 to 1,170 m asl.

Panellus ringens is not included in the Red list of fungi of Slovakia (LIZOŇ, 2001). Although the number of records of this species has been increasing, we think its habitats need preservation. As said above, *P. ringens* grows in the stands which are under the risk to be cut. In general, wetlands belong among the most endangered habitats all over the world. Many wetlands were destroyed after stream regulations and building water-storage reservoirs, and the other have been decreasing due to development of industrial zones, recreation centres and highways (HÁJEK and DITĚ, 2009). Because of these risk factors, we propose *P. ringens* to be red-listed in future as endangered species.

Panellus violaceofulvus was mostly recorded on *Abies alba*, rarely on *Picea abies* and once on *Pseudotsuga menziesii*. Basidiomata grew on branches, less on trunks and sporadically (two collections) on stumps (both on *Picea abies* stumps). Branches of 1–5 (10) cm in diam. were laying on the ground – they fell naturally or (in two cases) were piled into heaps after cutting. Fallen trunks were of 3–80 cm in diam. and the thinnest ones (3–5 cm in diam.) were the broken tree-tops. Most substrates (branches, trunks, stumps) were covered by bark; only once, basidiomata grew on wood (unbarked part) of trunk and once on wood of branch. The collections are from September to May (predominantly from colder months). Collections from summer months July and August are exceptional. *Panellus violaceofulvus* seems to be a forest species. It was found in basin *Quercus petraea* forests with *Abies alba*, in submontane *Fagus sylvatica* and *Quercus petraea* forests and *Fagus sylvatica* forests with *Abies alba*, in homogenous *Abies alba* forests, in typical Carpathian *Fagus sylvatica*, *Abies alba* and *Picea abies* forests, and in mountainous *Picea abies* forests with *Abies alba* and *Picea abies* forests with *Pinus*. One collection is from the forested area (“the area of environment management”) dominated by *Fagus sylvatica* and *Acer* spp., with admixed *Abies alba*, *Larix decidua*, *Pseudotsuga menziesii* and others.

According to HOLEC et al. (2015b), *P. violaceofulvus* prefers old-growth forests. We have found out that intensity of forest management probably does not play important role in the occurrence of this fungus. Generally, there are three categories of forests in Slovakia: a) commercial forests which are intensively managed, b) protection forests which are (resp. were) not managed or managed with specific intention to fulfil

preventative function of abiotic structures in landscape, and c) special-purpose forests which are managed with different intensity (often by selective cutting) or, in the case of national nature reserves, they are left to spontaneous development without any intervention (ANONYMUS, 2015). Our records of *P. violaceofulvus* were more or less proportionally distributed all over these forest categories. However, supporting HOLEC et al. (2015b), about third of the stands can be classified as old-growth forests (cf. forest naturalness classification by HOLEC et al., 2015a). The altitude of the collecting sites ranges from 350 to 1,123 m asl.

Panellus violaceofulvus is not included in the Red list of fungi of Slovakia (LIZOŇ, 2001) and we have no arguments to propose it to be red-listed even in future. In management view, *P. violaceofulvus* occurs in all forest categories. Our targeted search

for *P. violaceofulvus* in forests with at least 10% representation of *Abies alba* succeeded in almost every stand. Although *Abies alba* occurs in the forests of Slovakia only with the representation of 4%, it is not a rare tree species (ANONYMUS, 2015). In ten last years, the number of collections of *P. violaceofulvus* has almost tripled.

Ecology, occurrence and threat in Europe

Comparing our ecological findings on *Panellus ringens* and *P. violaceofulvus* with those of published in the selected literature (Table 2), they more or less correspond to each other. Some differences are in the host spectrum: PÖDER (1985) presented as hosts of *P. ringens* also *Betula* and *Alnus incana*; VESTERHOLT (2012) included among hosts of *P. ringens* also conifers and for *P. violaceofulvus* *Salix* spp.

Table 2. Comparison of the ecological characteristics of *Panellus ringens* and *P. violaceofulvus* in the selected literature and our own observations

Ecological characteristics	<i>Panellus ringens</i>	<i>Panellus violaceofulvus</i>
Our observations	on bark of fallen or standing branches and trunks of <i>Salix caprea</i> , <i>S. cinerea</i> , <i>S. pentandra</i> , <i>S. sp.</i> , (once) <i>Padus avium</i> ; September–March	on bark (rarely wood) of fallen branches, trunks, (rarely stumps) of <i>Abies alba</i> , <i>Picea abies</i> , (once) <i>Pseudotsuga menziesii</i> ; September–May (July, August)
MOSER (1983)	on deciduous wood; in winter	especially coniferous wood
PÖDER (1985)	on bark of deciduous trees, especially <i>Betula</i> spp. <i>Alnus incana</i> , <i>Salix</i> spp.	on bark of conifers, especially <i>Abies alba</i> and <i>Picea abies</i>
WATLING and GREGORY (1989)	on twigs, sticks and branches of frondose trees	–
BREITENBACH and KRÄNZLIN (1991)	on hardwoods, especially <i>Salix</i> , winter half of the year	on dead branches or small trunks of <i>Abies alba</i> ; winter to spring
KÄÄRIK (1992)	on bark of living or dead deciduous trees	–
VESTERHOLT (2012)	on deciduous wood, often on standing trees or still attached branches, rarely on conifers; autumn to late autumn	on <i>Salix</i> , in Central Europe also on conifers; autumn

As shown in Table 3, *Panellus ringens* and *P. violaceofulvus* are red-listed and/or occur in several European countries.

Table 3. Occurrence and threat of *Panellus ringens* and *P. violaceofulvus* in Europe

	A	CH	CZ	D	F	FIN	GB	I	LT	N	PL	S	UA
<i>Panellus ringens</i>	O	RL	O	RL	O	O	O	O	RL	O	RL	O	?
<i>Panellus violaceofulvus</i>	RL	O	RL	RL	O	?	?	O	RL	RL	RL	?	O

RL – red-listed species, O – species occurs in the country, ? – we are not sure if the species occurs in the country.

***Panellus ringens*.** A – Austria: O (Austrian Macological Society, pers. comm.), CH – Switzerland: RL (SENN-IRLET et al., 2007), CZ – the Czech Republic: O (SVRČEK, 1954), D – Germany: RL (BENKERT et al., 1996), F – France (ROUX, 2006), FIN – Finland (VESTERHOLT, 2012), GB – Great Britain: O (WATLING and

GREGORY, 1989), I – Italy: O (PÖDER, 1985), LT – Latvia: RL (ANDRUŠAITIS, 1996), N – Norway (VESTERHOLT, 2012), PL – Poland: RL (WOJEWODA and ŁAWRYNOWICZ, 2006), S – Sweden: O (VESTERHOLT, 2012).

Panellus violaceofulvus. A – Austria: RL (KRISAI-GREILHUBER, 1999), CH – Switzerland: O (BREITENBACH and KRÄNZLIN, 1991), CZ – the Czech Republic: RL (HOLEC and BERAN, 2006), D – Germany: RL (BENKERT et al., 1996), F – France: O (ROUX, 2006), I – Italy: O (PÖDER, 1985), LT – Latvia: (ANDRUŠAITIS, 1996), N – Norway: RL (BRANDRUD, 2015), PL – Poland: RL (WOJEWODA and ŁAWRYNOWICZ, 2006), UA – Ukraine: O (HOLEC, 2008).

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References

- ADAMČÍK, S., CHRISTENSEN, M., HEILMANN-CLAUSEN, J., WALLEYN, R., 2007. Fungal diversity in the Poloniny National Park with emphasis on indicator species of conservation value of beech forests in Europe. *Czech Mycology*, 59: 67–81.
- ANDRUŠAITIS, G. (ed.), 1996. *Latvijas Sarkanā Grāmata. Retās un izzūdošās augu un dzīvnieku sugas. 1. sējums* [Red data book of Latvia. Rare and endangered species of plants and animals, Vol. 1]. Rīga: LU Bioloģijas institūts.
- ANONYMUS, 2015. *Správa o lesnom hospodárstve v Slovenskej republike za rok 2014 (Zelená správa)* [Report on the status of forestry in the Slovak Republic of 2014 (Green Report)]. Bratislava: Ministerstvo pôdohospodárstva a rozvoja vidieka Slovenskej republiky. 86 p.
- BENKERT, D., DÖRFELT, H., HARDTKE, H.J., HIRSCH, G., KREISEL, H., KRIEGELSTEINER, G.J., LÜDERITZ, M., RUNGE, A., SCHMIDT, H., SCHMITT, J.A., WINTERHOFF, W., WÖLDECKE, K., ZEHFUSS, H.D., 1996. Rote Liste der Großpilze Deutschlands. *Schriftenreihe für Vegetationskunde*, 28: 377–426.
- BRANDRUD, T.E. (ed.), 2015. Sopper [Fungi]. In HENRIKSEN, S., HILMO, O. (eds). *Norsk rødliste for arter 2015*. Norge: Artsdatabanken, p. 132–156. [cit. 2016-03-17]. <http://www.artsdatabanken.no/File/2308/Norsk%20r%C3%B8dliste%20for%20arter%202015>.
- BREITENBACH, J., KRÄNZLIN, F., 1991. *Fungi of Switzerland, Vol. 3. Boletes and Agarics, Part 1*. Luzern: Verlag Mykologia. 361 p.
- HAGARA, L., 2014. *Ottova encyklopédia húb* [Otto's encyclopedia of fungi]. Praha: Ottovo nakladatelství, s. r. o. 1152 p.
- HÁJEK, M., DÍTĚ, D., 2009. Vodné a mokradové biotopy Karpát [Water and wetland biotopes of the Carpathians]. In KRÁLOVIČOVÁ, A., HERIANOVÁ, S. (eds). *Svet Karpát. Priručka k environmentálnej výchove*. Bratislava: Daphne – Inštitút aplikovanej ekológie, p. 103–128.
- HOLEC, J., 2008. Interesting macrofungi from the Eastern Carpathians, Ukraine and their value as bioindicators of primeval and near-natural forest. *Mycologia Balcanica*, 5: 55–67.
- HOLEC, J., BERAN, M. (eds), 2006. *Červený seznam húb (makromycetů) České republiky* [Red list of fungi (macromycetes) of the Czech Republic]. Příroda, 24. Praha: Agentúra ochrany prírody a krajiny. 282 p.
- HOLEC, J., KŘÍŽ, M., BERAN, M., KOLAŘÍK, M., 2015a. Chromosera cyanophylla (Basidiomycota, Agaricales) – a rare fungus of Central European old-growth forests and its habitat preferences in Europe. *Nova Hedwigia*, 100: 189–204.
- HOLEC, J., KŘÍŽ, M., POUZAR, Z., ŠANDOVÁ, M., 2015b. Boubínský prales virgin forest, a Central European refugium of boreal-montane and old-growth forest fungi. *Czech Mycology*, 67: 157–226.
- KAUTMANOVÁ, I., 2006. *Panellus ringens* rediscovered after 30 years. *Catathelasma*, 8: 33.
- KÄÄRIK, A., 1992. *Panellus* Karst. In HANSEN, L., KNUDSEN, H. (eds). *Nordic macromycetes, Vol. 2*. Copenhagen: Nordsvamp, p. 175–176.
- KNUDSEN, H., VESTERHOLT, J. (eds), 2012. *Funga Nordica*. Copenhagen: Nordsvamp. 1083 p.
- KRISAI-GREILHUBER, I., 1999. Rote Liste gefährdeter Großpilze Österreichs. In NIKLFELD, H. (ed.). *Rote Listen gefährdeter Pflanzen Österreichs*. Graz: Bundesministerium für Umwelt, Jugend und Familie, p. 229–266.
- KUTHAN, J., 1989. Soupis makromycetů sbíraných na průzkumných exkurzích (s myk. NDR) vednech 3. IX. – 9. IX. 1988 a na exkurzích „Setkání českých a slovenských mykologů pod Tatrami“ dne 10. IX. – 18. IX. na lokalitách v oblasti Vysokých a Nízkých Tater a v Slovenském rudohoří [The list of macromycetes collected during the reconnaissance excursions (with mycol. NDR) on the 3.IX.–9.IX. 1988 and during the excursions “Setkání českých a

- slovenských mykologů pod Tatrami” on the 10.IX.–18.IX. at the localities in the Vysoké Tatry Mts, Nízke Tatry Mts and Slovenské rudohorie Mts]. In KUTHAN, J. (ed.). *Houby rašelinišť a bažinatých lesů v Československu. Zborník referátů*. Praha: ČSVSM, p. 63–89.
- KUTHAN, J., ADAMČÍK, S., ANTONÍN, V., TERRAY, J., 1999. *Huby Národního parku Poloniny* [Fungi of the National Park Poloniny]. Liptovský Mikuláš: Správa národných parkov SR, Snina: Správa Národného parku Poloniny. 197 p.
- LIZOŇ, P., 2001. Červený zoznam húb Slovenska, 3. verzia (december 2001) [Red list of fungi of Slovakia, the 3rd draft (December 2001)]. *Ochrana Prírody*, 20 (Suppl.): 6–13.
- MIHÁL, I., BLANÁR, D., 2014. Fungi and slime molds of alder and willow alluvial forests of the upper part of the Muránka river (central Slovakia). *Folia Oecologica*, 41: 153–172.
- MIHÁL, I., GLEJDURA, S., BLANÁR, D., 2011. Makromycety (Zygomycota, Ascomycota, Basidiomycota) v masíve Kohúta (Stolické vrchy) [Macromycetes (Zygomycota, Ascomycota, Basidiomycota) in the massif of the Kohút Mountain (the Stolické vrchy Mts)]. *Reussia*, 6: 1–44.
- MOSER, M., 1983. *Keys to agarics and boleti (Polyporales, Boletales, Agaricales, Russulales)*. 4th ed. London: Roger Phillips. 535 p.
- PEIGER, M., TOMKA, P., PAULÍNÝ, M., 2015. *Huby Liptova* [Fungi of Liptov]. Ružomberok: Liptovské múzeum v Ružomberku. 168 p.
- PÖDER, R., 1985. *Panellus ringens* (Fr.) Romagn. e *P. violaceofulvus* (Batsch: Fr.) Sing. due rare tricholomataceae. *Bolletino del Gruppo Micologico G. Bresadola*, 28 (3–4): 101–106.
- RIPKOVÁ, S., ADAMČÍK, S., KUČERA, V., 2007. New, rare and less known macromycetes in Slovakia II. *Czech Mycology*, 59: 185–199.
- ROUX, P., 2006. *Mille et un champignons* [A thousand and one mushrooms]. Sainte-Sigolène: Édition Roux. 1224 p.
- SENN-IRLET, B., BIERI, G., EGLI, S., 2007. *Rote Liste der gefährdeten Grosspilze der Schweiz*. Bern: Umwelt-Vollzug. 92 p.
- SVRČEK, M., 1954. Druhý příspěvek k poznání mykoflory Českého středohoří [The second contribution to the knowledge of funga of the České středohoří Mts]. *Česká Mykologie*, 8: 129–134.
- ŠKUBLA, P., 2003. *Mycoflora Slovaca*. Šaľa: Self-editing. 1103 p.
- THIERS, B., 2016, continuously updated. *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium [cit. 2016-02-02]. <http://sweetgum.nybg.org/ih>
- VELLINGA, E.C., 1988. Glossary. In BAS, C., KUYPER, T.W., NOORDELOOS, M.E., VELLINGA, E.C. (eds). *Flora Agaricina Neerlandica, Vol. 1*. Rotterdam, Brookfield: A.A. Balkema, p. 54–64.
- VESTERHOLT, J., 2012. *Panellus* P. Karst. In KNUDSEN, H., VESTERHOLT, J. (eds). *Funga Nordica*. Copenhagen: Nordsvamp, p. 442–443.
- WATLING, R., GREGORY, N.M., 1989. Crepidotaceae, Pleurotaceae and other pleurotoid agarics. In HENDERSON, D.M., ORTON, P.D., WATLING, R. (eds). *British fungus flora. Agarics and Boleti, Vol. 6*. Edinburgh: Royal Botanic Garden, p. 1–157.
- WOJEWODA, W., ŁAWRYNOWICZ, M., 2006. Red list of macrofungi in Poland. In MIREK, Z., ZARZYCKI, K., WOJEWODA, W., SZELĄG, Z. (eds). *Red list of plants and fungi in Poland*. Kraków: W. Szafer Institute of Botany, Polish Academy of Sciences, p. 53–70.

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