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Notes on *Hapalopilus eupatorii* and *Erastia ochraceolateritia*

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Two species of polypores from the genus *Hapalopilus* s.l. are discussed. *Hapalopilus eupatorii* is published for the first time outside of Europe (Canary Islands) and in the Czech Republic. This species is shown to be more plastic in both morphology and ecology than previously thought. Revision of a type specimen of *Phaeolus rutilans* f. *resupinatus* has demonstrated that this taxon is microscopically different from *Hapalopilus eupatorii* in its spore shape. *Erastia ochraceolateritia* is published for the first time from the Czech Republic and Slovakia. The identities of these two species were confirmed both based on morphology and by sequencing of ITS DNA regions. Maps of their current and historic distribution in the Czech Republic and Slovakia are provided. A new combination, *Erastia aurantiaca*, is formally proposed.

Key words: *Phanerochaetaceae*, polypores, white-rot fungi, lignicolous fungi.

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Zíbarová L., Kout J., Tejklová T. (2021): Poznámky k hlináku bylinovému – *Hapalopilus eupatorii* a hlináku cihlovému – *Erastia ochraceolateritia*. – Czech Mycol. 73(1): 59–77.

Článek se zaobírá dvěma druhy chorošů z široce pojatého rodu hlinák (protože ani jeden z druhů nemá běžně užívané české jméno, navrhujeme je zde vytvořit; druhové jméno "bylinový" se vztahuje k převažujícímu substrátu, "cihlový" pak k barvě starších nebo sušených plodnic). Hlinák bylinový (*Hapalopilus eupatorii*) je uváděn z pěti lokalit z České republiky a poprvé publikován také z území mimo Evropu (Kanárské ostrovy). Nově zjištěná data ukázala, že jde o morfologicky i ekologicky více plastický druh, než se doposud soudilo. Revizí typové položky *Phaeolus rutilans* f. *resupinatus* bylo zjištěno, že tento taxon se od hlináku bylinového mikroskopicky liší tvarem výtrusů. Hlinák cihlový (*Erastia ochraceolateritia*) je publikován poprvé z České republiky a ze Slovenska. Identita obou druhů byla potvrzena na základě morfologie a sekvenace ITS úseků DNA. Jsou poskytnuty mapy jejich současného a historického rozšíření v České republice a na Slovensku. Je formálně vytvořena nová kombinace *Erastia aurantiaca*.

Introduction

The genus *Hapalopilus* P. Karst. in its traditional concept (e.g. Ryvarden et Gilbertson 1993) included polypore species with rather vague characters – soft context, monomitic hyphal system, clamped hyphae, absence of any cystidia, ellipsoid to cylindrical, inamyloid, thin-walled spores – with the only striking one the colourful (reddish to purplish) macrochemical reaction of basidiocarps with a KOH solution. In *Hapalopilus rutilans* (Pers.) Murrill (the type species of the genus) this reaction is caused by polyporic acid, which is abundant in its basidiocarps (Kraft et al. 1998), but compounds causing reactions with KOH are not well known in other species. However, by utilising molecular methods it was later shown that *Hapalopilus* is polyphyletic (Ko et al. 2001) and the genus *Erastia* Niemelä et Kinnunen was erected to accommodate the conifer-dwelling *Hapalopilus salmonicolor* (Berk. et M.A. Curtis) Pouzar (Niemelä et al. 2005). Later also the species *Hapalopilus ochraceolateritius* (Bondartsev) Bondartsev et Singer was combined into this genus by Zmitrovich (2018). Other species formerly placed in the genus – such as *Hapalopilus croceus* (Pers.) Donk – were also shown to be unrelated to *H. rutilans* (Dvořák et al. 2014). In the current concept (Miettinen et al. 2016), the genus *Hapalopilus* is therefore restricted to *H. rutilans* and three closely related species, *Hapalopilus eupatorii* (P. Karst.) Spirin et Miettinen, *Hapalopilus ribicola* (P. Karst.) Spirin et Miettinen and *Hapalopilus percoctus* Miettinen, with exception of the last, all occurring in Europe. In addition, Pilát (1935) described (as *Phaeolus rutilans* f. *resupinatus*) a resupinate form of *Hapalopilus rutilans*, which had however not been compared to these newly described species, namely *Hapalopilus eupatorii*, similar in macroscopical aspect.

While *Hapalopilus rutilans* is well known and widespread, other species currently or formerly placed in *Hapalopilus* are rarer and obscure. Two of them – *Hapalopilus eupatorii* (P. Karst.) Spirin et Miettinen and *Erastia ochraceolateritia* (Bondartsev) Zmitr. – were recently collected by the authors for a first time in the Czech Republic and several other countries. The aim of this article is to present additional data on the morphological variability, ecology and distribution of both species and to clarify the identity of *Phaeolus rutilans* f. *resupinatus*.

Material and methods

Macroscopic characters were observed on fresh and dry material and photographs taken in situ. Microscopic features were examined at 1000× magnification under an oil immersion lens mainly in Melzer's reagent; Cotton Blue in lactic acid, Congo Red in 10% ammonia, 5% KOH solution, and tap water were also used. Microscopic observations including measurements were carried out on dried material

(see Material studied). Dimensions of spores were derived from measurements of at least 25 individual spores in Melzer's reagent. The spores were measured directly under an optical microscope using an eyepiece micrometer with a precision of 0.25 µm. Deformed or otherwise abnormal spores were omitted from the measurements.

The identification of the specimens was based on the descriptions in Miettinen et al. (2016) for *Hapalopilus eupatorii*, and in Ryvarden et Melo (2017) for *Erastia ochraceolateritia*, supplemented with ITS segment sequencing (methods followed according to Vlasák et Kout 2011) for selected specimens (*Hapalopilus eupatorii*: HR B009349; *Erastia ochraceolateritia*: HR 102060 and C.B.G.: JK1908/22) and comparison with available data in GenBank (https://www.ncbi.nlm.nih.gov/genbank/).

The specimens were dried at room temperature or in an electric dryer, stored in PE bags with a slide fastener. Voucher specimens are now deposited in the herbarium of the Museum of Eastern Bohemia in Hradec Králové (HR) and the herbarium of the University of West Bohemia (abbreviated C.B.G. here).

We searched for material of *Hapalopilus* in major herbaria of the Czech Republic and Slovakia (BRA, BRNM, CB, HR, PRM) and revised all available material of *Hapalopilus salmonicolor* s.l. and selected material of *Hapalopilus rutilans*. The selection was based on a combination of morphology (small effused or effused-reflexed specimens) and "atypical" substrate (herbaceous and woody substrates not belonging to *Aceraceae*, *Betulaceae*, *Fagaceae* or *Pinaceae*). Herbarium labels were translated from Czech and Norwegian into English, others (in English or Latin) are presented in their original wording; our additions are given in square brackets.

Nomenclature of plants follows Kaplan (2019). Abbreviations of herbaria follow Thiers (on-line).

Abbreviations used: ACR – Congo Red in 10% ammonia; avg. – range of average values in particular collections; C.B.G. – herbarium of Department of Biology, Geosciences and Environmental Education, Faculty of Education, University of West Bohemia; det. – identified by; leg. – collected by; L.Z. – private herbarium of L. Zíbarová; NNM – National Nature Monument; NR – Nature Reserve; n_{spec} – number of specimens from which the average value is calculated; Q – range of spore length to width ratio; Q_{avg} – range of average Q values in particular collections; rev. – revised by.

Results

Hapalopilus eupatorii (P. Karst.) Spirin et Miettinen, MycoKeys 17: 15, 2016
Figs. 1, 2a–b

≡ *Physisporus eupatorii* P. Karst. – *Poria eupatorii* (P. Karst.) Sacc.
= *Ceriporiopsis herbicola* Fortey et Ryvarden

Macroscopic description. Basidiocarps annual, resupinate, semipileate or pileate, starting as small orbicular bodies, later confluent, often accompanied

Fig. 1. *Hapalopilus eupatorii*. **a** – fresh basidiocarps, Nová Ves, Czech Republic (HR B009349); **b** – fresh basidiocarps, Merklovice, Czech Republic (HR B009348); **c** – fresh basidiocarps, Barranco valley, Canary Islands, Spain (C.B.G.: JK1312/19, TFC Mic. 24896 dupl.); **d** – habitat of *Hapalopilus eupatorii*, Merklovice, Czech Republic. Photo J. Kout (c), L. Zíbarová (a), P. Petelík (b, d).

by an extensive ochre subiculum forming patches up to several cm^2 large. Resupinate specimens 4.5–12 mm long, 4–6.5 mm wide, 2–3 mm thick, with lighter, fimbriate margin; context 0.5–1.5 mm thick. Pileate specimens with single or several imbricate pilei up to 9 mm long, 16 mm wide and 4 mm thick, upper surface smooth and matt to slightly hispid, ochre, light rusty brown, darkening towards the centre, azonate, context up to 2 mm thick. Tubes up to 2(–2.5) mm long. Pores slightly angular, entire, isodiametric, 2–4 per mm, becoming smaller towards the margin, not decurrent to the substrate in pileate specimens, ochre to rusty brown. Context and/or subiculum soft, more or less concolorous with tubes, homogeneous. Smell faint, slightly acidulous, in specimen herb. L.Z. 8537. Taste not tested.

Dry specimens. Soft and somewhat brittle, (light) ochre.

Macroscopic reactions. Purple reaction to 5% KOH in all parts of basidiocarps, both in fresh and dried state.

Microscopic description. Context and subiculum with monomitic hyphal system; hyphae with clamps, slightly thick-walled (walls up to 0.75 µm,

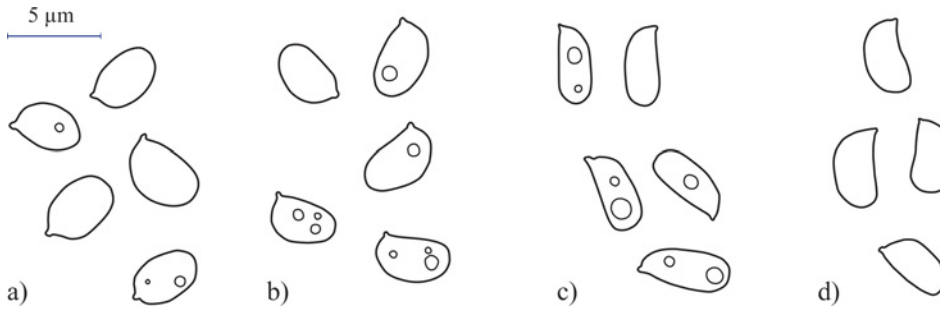


Fig. 2. Line drawing of spores. *Hapalopilus eupatorii*: **a** – HR B009349, **b** – HR B009348; **c** – *Erastia ochraceolateritia* (HR 102060); **d** – *Phaeolus rutilans* f. *resupinatus* (PRM 807903). Scale bar = 5 µm. Del. L. Zíbarová.

swelling conspicuously, up to 2 µm, in KOH and ACR), loosely and irregularly arranged (space between hyphae often filled by amber pigment soluble in KOH and ACR, in KOH forming large rectangular purple crystals), hyaline but with abundant amber-coloured incrustation (in Melzer's reagent, partly dissolving in KOH and ACR), 4–6 µm in diam., some bladder-like inflated segments up to 15 µm in diam. present. Surface of pileus poorly differentiated from context, hyphae irregularly arranged, with abundant incrustation, 6–7 µm in diam. Trama with monomitic hyphal system; hyphae with clamps, hyaline but with similar incrustation to contextual hyphae, slightly thick-walled (walls up to 0.5 µm thick, swelling up to 1 µm in KOH and ACR), sparingly branched, subparallel, 2.5–4 µm in diam. Cystidial elements absent. Dissepiments sterile, terminal elements not distinctly differentiated, obtuse, 3–3.5 µm in diam. Basidia clavate, (2–)4-spored, 14–18 × 3.5–4 µm, with a basal clamp. Basidiospores elliptic to ovoid, adaxial side usually convex or straight, rarely slightly concave, hyaline, thin-walled, acyanophilous, neither amyloid nor dextrinoid, 3.5–4.5 × (2.25)2.5–3 µm (avg. 3.90–4.26 × 2.63–2.84 µm, n_{spec} = 5); Q = 1.3–1.8 (Q_{avg} = 1.49–1.62, n_{spec} = 5).

E c o l o g y. Our Czech records of *H. eupatorii* are from stems of robust tall herbaceous plants (*Arctium* sp., *Reynoutria* cf. *japonica*), a thin trunk of a liana (*Wisteria sinensis*) or bush (*Frangula alnus*). The associated habitats were tall herb vegetation on former agricultural soil, a *Reynoutria* stand in wet alder forest, and a botanical garden. Pilát's record is from *Robinia pseudoacacia* (ca 1.5 cm thick branch) without any other data on its ecology given. The record from the Canary Islands was collected on the woody shrub *Plocama pendula*, on a branch near the ground in Barranco valley. The branch was mostly covered with bark and *Hapalopilus* grew mainly on these parts, while attached debris was grown through by subiculum. The Barrancos are characteristic rocky valleys on some

islands in Macaronesia. They are often deep and rocky, dry in summer and are covered with scanty vegetation.

Type of rot. White rot.

Molecular analysis. Both of our sequenced specimens show a high degree of similarity (more than 99%) to sequences of *Hapalopilus eupatorii* in GenBank (KX752620, KX752621) derived from the specimens of *H. eupatorii* used in the phylogeny by Miettinen et al. (2016).

Material studied

Czech Republic. Central Bohemia. Davle [Praha-západ District], [a branch of] *Robinia pseudoacacia*, May 1932 leg. et det. A. Pilát [as *Phaeolus nidulans* (Fr.) Pat.], rev. L. Zíbarová (PRM 807919). – Lysá nad Labem [Nymburk District], Hrabanovská černava NNM, willow scrub, standing thin dead trunk of *Frangula alnus*, 12 Jun 2020 leg. et det. L. Zíbarová (herb. L.Z. 8537). – East Bohemia. Merklovice (Rychnov nad Kněžnou District), 3.5 km east-southeast of train station in Vamberk, 490 m a.s.l., fragment of wet alder-birch stand surrounded by spruce plantation, underside of fallen stem of *Reynoutria* cf. *japonica*, 5 Mar 2019 leg. P. Petelík, det. L. Zíbarová (HR B009348). – North Bohemia. Nová Ves (Louny District), 420 m west-southwest of village chapel, tall herb vegetation on unmanaged meadow, base of standing stem of *Arctium* sp., 1 Jul 2014 leg. et det. L. Zíbarová, rev. J. Kout (HR B009349). – Teplice (Teplice District), botanical garden, pergola, base of thin dead trunk of *Wisteria sinensis*, 29 Dec 2016 leg. T. Tejklová et L. Zíbarová, det. L. Zíbarová (HR 102209).

Spain. Canary Islands. Tenerife (south), El Barranco de Herques (El Escobonal), Barranco valley, on wood of *Plocama pendula*, 19 Dec 2013 leg. et det. J. Kout as *Hapalopilus nidulans*, rev. by sequencing as *H. eupatorii* (C.B.G.: JK1312/19, TFC Mic. 24896 dupl.).

Type specimen of *Phaeolus rutilans* f. *resupinatus* Pilát (PRM 807933)

Figs. 2d, 3

Macroscopic description. The specimen consists of several small fragments of angiosperm bark, parts of basidiocarps are present on two of them, only a few remnants of subiculum on the other fragments. Basidiocarp completely resupinate in two fragments (11 × 6 mm and 10 × 4.5 mm). Pores slightly angular, entire, more or less isodiametric to somewhat elongate near margin, light ochre, 2–3.5 per mm; tubes up to 1.25 mm long; subiculum (context) 0.3 mm thick, soft, paler than tubes, homogeneous. Margin paler than pores, finely fimbriate, up to 1 mm wide.

Macroscopic reactions. Not tested, but violet discoloration in part of specimen is evident, possibly due to previous testing with alkalis.

Microscopic description. Subiculum (context) with monomitic hyphal system; hyphae with clamps, slightly thick-walled (walls up to 0.5 µm, swelling conspicuously, up to 1.5 µm, in KOH), loosely and irregularly arranged, spaces between hyphae often filled by amber pigment (soluble in KOH), hyaline but with abundant amber-coloured (in Melzer's reagent) incrustation which dissolves in KOH, 4–5.5 µm in diam. Trama with monomitic hyphal system; hyphae with clamps,

Fig. 3. Type specimen of *Phaeolus rutilans* f. *resupinatus* (PRM 807903). Photo archive of Department of Mycology, National Museum, Prague.

hyaline but with similar incrustation to subicular hyphae, slightly thick-walled to thin-walled (walls up to 0.5 µm thick), sparingly branched, subparallel, 2.5–3.5 µm in diam. Cystidial elements absent. Dissepiments sterile, terminal elements not distinctly differentiated, obtuse, 2.5–3.5 µm in diam. Basidia clavate, (2–)4-spored, 14–16 × 3.75–4 µm, with a basal clamp. Basidiospores oblong ellipsoid, adaxial side usually straight or slightly concave, hyaline, thin-walled, acyanophilous, neither amyloid nor dextrinoid, 3.5–4.25 × 2–2.5 µm (avg. 3.95 × 2.13 µm); Q = 1.6–2.1 (Q_{avg} = 1.86).

Material studied

Russia. Siberia, distr. Narymicus, *Prunus padus*, Oct 1933 leg. Krawtzew (PRM 807933).

Erastia ochraceolateritia (Bondartsev) Zmitr., Folia Cryptogamica Petropolitana (Sankt-Peterburg) 6: 97, 2018 Figs. 2c, 4, 5

≡ *Poria ochraceolateritia* Bondartsev – *Hapalopilus ochraceolateritius* (Bondartsev) Bondartsev et Singer

= *Hapalopilus salmonicolor* (Berk. et M.A. Curtis) Pouzar s. auct. eur. p.p.

Macroscopic description. Basidiocarps annual, resupinate, forming dark edges on sloping parts. Specimens up to 150 mm long, 90 mm wide, up to 6.5 mm thick; subiculum (context) 0.5–1.5 mm thick. Margin not rhizomorphic, velvety, dull orange. Pores circular, entire, isodiametric, 4–5 per mm, elongated on sloping substrate, up to 2 per mm, dull orange, older and bruised parts discolouring

Fig. 4. *Erastia ochraceolateritia.* **a** – fresh basidiocarp ex situ, Oldřichov, Czech Republic (HR 102060); **b** – fresh basidiocarp, Jedliny NR, Slovakia (C.B.G.: JK1908/22, PRM 953782). Photo T. Tejklová (a), L. Hejl (b).

to brown. Tubes up to 2–5.5 mm long, dull orange-brown, darker than pore surface. Subiculum (context) soft, slightly paler than tubes, homogeneous. Smell citrus fruit-like (reminding mixture of orange and bergamot) in specimen HR 102060. Taste not tested.

Dry specimens. Hard and brittle, brick red in subiculum and unbruised parts, black-brown and resinous in bruised parts.

Macroscopic reactions. Subiculum with brown-red to dark purple reaction to 5% KOH in dried state.

Microscopic description. Subiculum in sterile margin of basidiocarps with pseudodimitic hyphal system, typical generative hyphae with numerous clamps, thin-walled, 2–4 µm in diam., pseudo-binding hyphae conspicuous, with sparse clamps, thick-walled (walls up to 1.5 µm) with thin lumen, irregular, dichotomously branched to the second or third order, often strongly amyloid, 2–4 µm in diam., apices obtuse, often thin-walled (somewhat resembling cystidia of *Tubulicrinis*). Subiculum (context) with pseudodimitic hyphal system; typical generative hyphae with clamps, slightly thick-walled (walls up to 1 µm, not swelling in KOH), loosely and irregularly arranged, hyaline to pale reddish brown but with abundant reddish incrustation (partly dissolving in Melzer's reagent) and

amorphous refractive material between the hyphae, 2.5–4.5 µm in diam.; pseudobinding hyphae up to 150 µm long, richly dichotomously branched, sometimes with thin and short side branches, often irregular and twisted, thick-walled (walls up to 1.5 µm), sometimes with thin lumen, walls weakly to strongly amyloid. Trama with monomitic hyphal system, hyphae with clamps, hyaline, glued together by reddish pigment (amber in Melzer's reagent), tightly packed and often difficult to discern, thin-walled, sparingly branched, subparallel, 2.5–3.5 µm in diam. Cystidial elements absent. Dissepiments sterile, terminal elements hard to observe, not distinctly differentiated, obtuse, 2.5–3.5 µm in diam. Basidia clavate, 4-spored, 16–18 × 4.5–5.5 µm, with a basal clamp. Basidiospores cylindrical to weakly allantoid, adaxial side usually concave, rarely straight, hyaline, thin-walled, often with one or two inclusions, acyanophilous, neither amyloid nor dextrinoid, (3.75)4–4.5(4.75) × (1.5)1.75–2(2.25) µm (avg. 4.10–4.20 × 1.88–1.91 µm, n_{spec} = 3); Q = 1.9–2.7 (Q_{avg} = 2.15–2.24, n_{spec} = 3).

Ecology. Our only record of *Erastia ochraceolateritia* from the Czech Republic is from a stump of a conifer (possibly *Picea abies*) in an advanced stage of decay in an otherwise unremarkable conifer plantation. In Slovakia, we found *E. ochraceolateritia* on a decayed stump of *Picea abies* in a spruce-fir forest with dead spruces and waterlogged by a nearby stream in a foothill of the Tatra Mountains. Older herbarium specimens from both countries provide little information on its ecology.

Type of rot. White rot, cracks in wood filled with whitish mycelium.

Molecular analysis. We confirmed our newly recorded specimens from the Czech Republic (HR 102060, GenBank accession no. MN318463.1) and Slovakia (C.B.G.: JK1908/22) by sequencing, resulting in more than 99% similarity to sequence MN318462.1 from Russia (H: Spirin 4749, C.B.G. dupl.).

Material studied

Czech Republic. Central Bohemia. Hřebečníky (Rakovník District), [Mt. Malinová hora according to Kotlaba 1984], ad trunc. valde putrid.?, 16 Oct 1940 leg. J. Herink (as *Poria aurantiaca*; PRM 139515). – Oldřichov u Mladé Vožice (Tábor District), site named 'Oldřichovské lesy', 510 m a.s.l., cultural pine-spruce forest, verge of forest track, decayed stump of conifer (*Picea abies*?), 29 Sep 2016 leg. T. Tejklová, J. Dubec et J. Kramoliš, det. P. Vampola et J. Vlasák (HR 102060).

Slovakia. Montes Slovenské Rudohorie, in cacumine montis 'Fabova hoľa', 10 Aug 1950 leg. M. Svrček et A. Příhoda, det. Z. Pouzar (as *Sarcoporia salmonicolor*; PRM 814693). – Tatra National Park, Jedliny NR, approx. 700 m a.s.l., spruce-fir forest, in rather open, waterlogged part, old decayed stump (probably *Picea abies*), 22 Aug 2019 det. J. Kout (C.B.G.: JK1908/22, PRM 953782 dupl.).

Germany. Niedersachsen, Brückendorf (Kreis Lüchow-Dannenberg), near the Elbe (about 100 km SE of Hamburg), on the underside of fallen (∅ 40 cm) trunk of *Pinus sylvestris*, 7 Nov 1969 leg. E. Jahn, det. J. Jahn (PRM 870916).

Norway. Buskerud, Rollag, tundra, stream gorge, 370 m a.s.l., rich spruce- and mixed forest, old natural forest, on thick trunk (R3/5) of *Pinus sylvestris*, 24 Jun 2006 leg. et det. T.H. Hofton, G. Gaarder, Ø. Røsok, H. Rinde, rev. T. Niemelä (O 283460).

Fig. 5. Comparison of dried basidiocarps of *Erastia ochraceolateritia* (above, HR 102060) and *E. aurantiaca* (below, PRM 522048). Scale bar = 15 mm. Photo L. Zíbarová.

Poland. Białowieża, silva mixta virginea, ad truncum emortuum *Piceae excelsae* humi iacentem, 20 Oct 1963 leg. et det. S. Domański (as *Hapalopilus ochraceo-lateritius*; PRM 971106).

Russia. Leningrad Reg., Tikhvin Dist., Gornyi rivulet, on *Picea abies*, 21 Jul 2012 leg. et det. V. Spirin (H: Spirin 4749, C.B.G. dupl.).

Erastia aurantiaca (Rostk.) Miettinen et Niemelä ex Zíbarová, Kout et Tejklová**, comb. nov.** Fig. 5

MycoBank MB 838948

Basionym: *Polyporus aurantiacus* Rostk., Deutschlands Flora, Abt. III. Die Pilze Deutschlands 4–17: 119, t. 58, 1838

≡ *Hapalopilus aurantiacus* (Rostk.) Bondartsev et Singer

In the course of the present study, also the closely related species *Erastia aurantiaca* became subject to scrutiny. Because this combination in the genus *Erastia* has not been validly published (Niemelä 2016) according to Art. 41.1, F.5.1 (Turland et al. 2018), we provide its valid publication here.

Material studied

Czech Republic. South Bohemia. Vodňany ('Černohájˈ) [Strakonice District], 18 Jul 1936 leg. J. Herink, det. Z. Pouzar (as *Poria aurantiaca*; PRM 28037). – Svinětice [Strakonice District], piscida Rožboud, 410 m a.s.l., 17 Jul 1946 leg. J. Herink, det. Z. Pouzar (as *P. aurantiaca* Rostk.; PRM 522048).

Norway. Telemark, Bø, south of Bryggefjell, 489 m a.s.l., southern boreal mixed forest, on dry trunk of *Picea abies*, 28 Sep 2010 leg. et det. T. Høitomt, rev. T.H. Hofton (O 242926).

DISCUSSION

Taxonomy and similar species

Hapalopilus eupatorii was originally described as *Physisporus* (*Antrodia*) *eupatorii* by Karsten (1884) based on a collection recorded on dead stems of the herb *Eupatorium* (*Asteraceae*) in North France. However, the name was misinterpreted and the species was later described again by Fortey et Ryvarden (2007) as *Ceriporiopsis herbicola*. Miettinen et al. (2016) studied both species and found them conspecific and returned it to the attention of mycologists.

Hapalopilus eupatorii is one of the four closely related species retained in *Hapalopilus* s.str. (Miettinen et al. 2016). The African *Hapalopilus percoctus* is known only from the type locality, all other species (*H. eupatorii*, *H. rutilans* and *H. ribicola*) are known from Europe. The differences between these three species are small – a combination of macromorphology (effused or pileate basidiocarps and their size), micromorphology (width of spores and tramal hyphae) and ecology (substrate) is needed for identification. According to Miettinen et al. (2016, see Tab. 3 there) *Hapalopilus eupatorii* is defined by small, strictly effused basidiocarps, wide spores (avg. width = 2.75 µm, Q_{avg} = 1.44), narrow tramal hyphae (median 3.0 µm) and growth on dead herbaceous stems or branches of *Robinia*. However, apart from two effused specimens on more or less horizontal substrates we also recorded a distinctly pileate specimen on a standing stem of *Arctium* sp. (HR B009349) which matches sequences of *H. eupatorii* in Miettinen et al. (2016). Also another (unsequenced) specimen (herb. L.Z. 8537) formed well-developed pilei. Therefore, it seems that the morphology of basidiocarps in *H. eupatorii* is significantly influenced by substrate orientation – it prefers to form effused (or effuso-reflexed) specimens on the underside of fallen stems, but may form pileate ones on standing stems (i.e. when there is no underside). Also we suspect that small basidiocarps in *H. eupatorii* are related to the small size (and therefore limited available resources) of its substrate and are not a reliable diagnostic character. However, in our opinion, besides ecology (preference for woody herbaceous stems in *H. eupatorii* vs. coarse wood in *H. rutilans*), *H. eupatorii* can still be distinguished from the widespread

H. rutilans by its wider spores (≥ 2.6 µm in average). Although the difference is often small, it seems to be consistent. Also, spores tend to be more cylindrical-ellipsoid in *H. rutilans* in contrast to ovoid-ellipsoid ones in *H. eupatorii*, even if the Q-values of the spores may overlap.

According to Miettinen et al. (2016), *H. ribicola* is phylogenetically and morphologically closely related to *H. eupatorii*. It forms small basidiocarps which are effused or with poorly developed pilei on thin, still attached branches of *Ribes* spp. and has likewise wide spores; it has so far only been recorded in Finland. Apart from its ecology, it is distinguished by its relatively narrow spores (Q_{avg} = 1.64) and wide tramal hyphae (median = 3.7 µm; Miettinen et al. 2016). We have not seen any material of *H. ribicola* but the Q value given for this species is almost identical to our (sequenced) material of *H. eupatorii* (Q_{avg} = 1.62) and is perhaps of little taxonomic value. Similarly, dimensions of tramal hyphae of *H. eupatorii* in our specimens were larger than given for this species by Miettinen et al. (2016) and come closer to those of *H. ribicola* (data not shown). It might be the case that both species are practically indistinguishable based on morphology.

Dämmrich (2014) published a record from *Reynoutria* as *Hapalopilus rutilans* f. *resupinatus*. We have revised A. Pilát's type specimen of *Phaeolus rutilans* f. *resupinatus* and found it is well preserved but unfortunately almost sterile for the most part. While it is morphologically very close to *Hapalopilus eupatorii*, the few spores we managed to find are on average narrower (both absolutely and relatively) than in *H. eupatorii*. Also its substrate (*Padus*) is not in line with the preferences of this species, so we conclude that these two are not conspecific. Nevertheless, we doubt if *Phaeolus rutilans* f. *resupinatus* is just a resupinate form of *H. rutilans* or possibly another cryptic species. More collections from the original area and substrate should be made and eventually sequenced.

Erastia ochraceolateritia was often included in *Hapalopilus salmonicolor* (Berk. et M.A. Curtis) Pouzar in the older European literature (e.g., Kotlaba 1984 mentions *Sarcoporia salmonicolor* and *Hapalopilus ochraceolateritius* as synonyms). However, Niemelä et al. (2005) recognized three species in this complex in North Europe – namely *Erastia salmonicolor* (Berk. et M.A. Curtis) Niemelä et Kinnunen, *Hapalopilus aurantiacus* (Rostk.) Bondartsev et Singer, and *Hapalopilus ochraceolateritius* (Bondartsev) Bondartsev et Singer. In their subsequent work, Niemelä et al. (2012), after investigating isotype collections, stated that *Polyporus salmonicolor* Berk. et M.A. Curtis in its original sense is different from the concept of Niemelä et al. (2005) and therefore described *Aurantiporus priscus* Niemelä, Miettinen et Manninen for *Erastia salmonicolor* sensu Niemelä et al. (2005)[1]. In fact, according to Niemelä et al.

[1] Solving the phylogenetic position of this species may be an interesting question, unfortunately beyond the scope of this article.

(2012), *Polyporus salmonicolor* is much closer to *H. aurantiacus* and *H. ochraceolateritius*, sharing thin-walled hyphae and amyloid hyphae in the subiculum, but since it was originally described from America, the name should not be used for European collections in the opinion of Niemelä et al. (2012). Niemelä (2016) combined both *H. ochraceolateritius* and *H. aurantiacus* into *Erastia*, but both combinations are invalid (Art. 41.1, F.5.1). Zmitrovich (2018) combined *Hapalopilus ochraceolateritius* (Bondartsev) Bondartsev et Singer into *Erastia*, but that left the clearly closely related *Hapalopilus aurantiacus* out of this genus, which is why we rectify this situation by creating the new combination *Erastia aurantiaca* (Rostk.) Miettinen et Niemelä ex Zíbarová, Kout et Tejklová (see above).

Niemelä et al. (2005) provided a comparison of *Aurantiporus priscus* (as *Erastia salmonicolor*), *E. ochraceolateritia* and *E. aurantiaca*. *Aurantiporus priscus* can be reliably distinguished from the other two species by e.g. paler, less brightly coloured basidiocarps, almost unchanging while bruised, a negative or weak KOH reaction (blood-red in *Erastia*), absence of amyloid hyphae in the subiculum and ellipsoid spores (more or less cylindrical in *Erastia*). Differentiating between both *Erastia* species is more difficult and based on the colour of fresh and dried basidiocarps, pore size and spore dimensions. This would seem sufficient in practice, but in reality, polypore specimens are (unlike agarics) seldom thoroughly macroscopically described in fresh state, pore size is much larger in basidiocarps on sloping substrates, and from our experience with herbarium material from PRM, it is often difficult to find sufficient spores in preparations from *Erastia* spp. due to abundant resinous material, so that several slides must be examined to obtain a set of measurements which is large enough. In addition, our specimen of *E. ochraceolateritia* from the Czech Republic was paler and more vividly orange than indicated by Niemelä et al. (2005) for that species ("brick or terracotta") or photos in Rivoire (2020), but close in colour shade to photos in Niemelä (2016) or Bernicchia et Gorjón (2020). Nevertheless, our revision of the material deposited in PRM provided two distinct groups – the first with paler ochre fruitbodies (in exsiccata) in unbruised parts, larger pores and wider spores, which we ascribe to *E. aurantiaca* and the second with darker brick fruitbodies in unbruised parts (in exsiccata), small pores and narrower spores (Tab. 1) similar to our records of *E. ochraceolateritia*.

Other European polypores on conifer wood such as *Physisporinus crocatus* (Pat.) F. Wu, Jia J. Chen et Y.C. Dai and *Auriporia aurulenta* A. David, Tortić et Jelić could be macroscopically similar to *Erastia ochraceolateritia* but both have completely different microscopical characters – subglobose spores and simple septate hyphae in the former, incrusted cystidia in the latter, and both species also lack amyloid hyphae in the subiculum.

Tab. 1. Averages of spore dimensions measured on selected specimens (Q – length/width ratio).

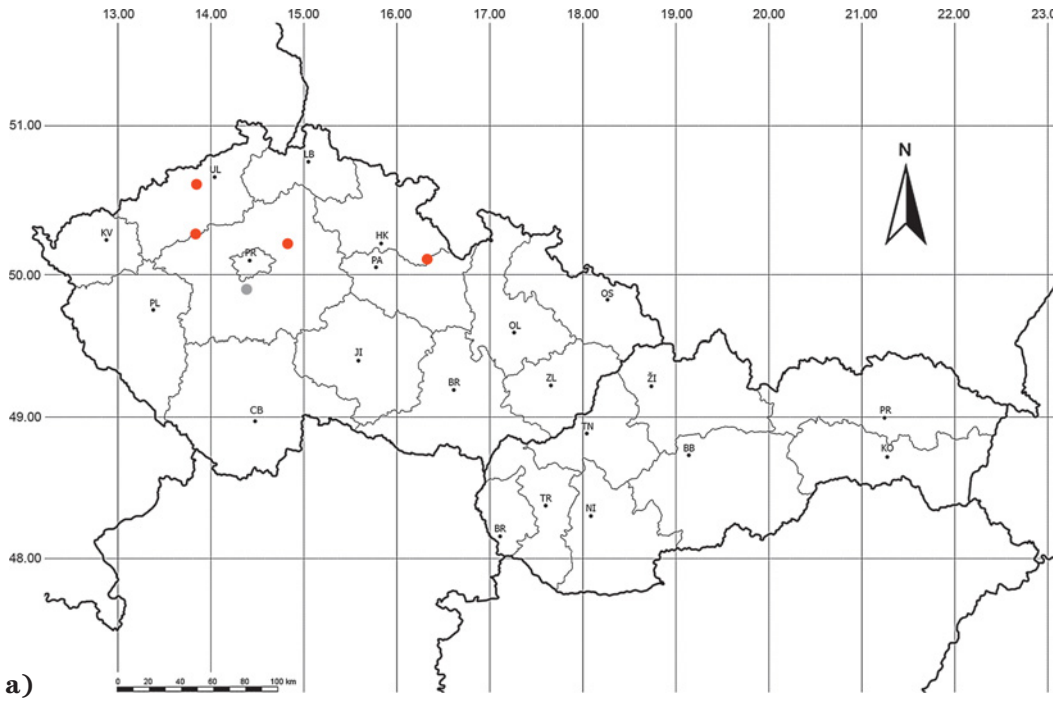
Species	Specimen	length (µm)	width (µm)	Q
Hapalopilus rutilans	HR 94056	4.4	2.3	1.90
Hapalopilus rutilans	HR 90189	3.7	2.3	1.58
Hapalopilus eupatorii	L.Z. 8537	3.9	2.8	1.38
Hapalopilus eupatorii	HR 102209	4.2	2.8	1.49
Hapalopilus eupatorii	HR B009349	4.3	2.6	1.62
Hapalopilus eupatorii	HR B009348	4.1	2.7	1.52
Hapalopilus eupatorii	PRM 807919	4.0	2.8	1.40
Phaeolus rutilans f. *resupinatus*	PRM 807933	4.0	2.1	1.86
Erastia ochraceolateritia	HR 102060	4.1	1.9	2.15
Erastia ochraceolateritia	PRM 814693	4.2	1.9	2.25
Erastia ochraceolateritia	PRM 139515	4.2	1.9	2.22
Erastia aurantiaca	PRM 28037	4.2	2.2	1.92
Erastia aurantiaca	PRM 522048	4.4	2.2	2.02

Kotlaba (1984) mentions three localities of *Sarcoporia salmonicolor* (in a wide sense, see above) for the Czech Republic and a single one for Slovakia, all records older than 70 years. Revising the material, we conclude that two (PRM 28037, PRM 522048) of the Czech records match *Erastia aurantiaca*, while the remaining one (PRM 193515) and the Slovak specimen (PRM 814693) are *E. ochraceolateritia*. There are no records of *Erastia* spp. from the Czech Republic since Kotlaba's (1984) publication. Interestingly, we did not identify any Czech herbarium specimens of *Aurantiporus priscus*.

Ecology and distribution

Hapalopilus eupatorii (Fig. 6a). Until recently, *H. eupatorii* was mostly known from temperate Europe – Denmark, England, France and Germany (Miettinen et al. 2016, Bernicchia et Gorjón 2020, Rivoire 2020). Our records and historical records from the Czech Republic are in line with these observations. There is a record from southern France bordering on the Mediterranean climate region (Rivoire 2020). The data from Slovakia (Bratislava Nová Ves) in Bernicchia et Gorjón (2020) is an error due to miscommunication (actually referring to specimen HR B009349 in this study). However, our collection from Macaronesia (Canary Islands) considerably expands its known distribution and ecological range. *Hapalopilus eupatorii* was recorded there on *Plocama pendula* (*Asteraceae*), a woody shrub or short tree endemic to the islands, but it might highly probably be found there on a broader range of substrates.

Fig. 6. Distribution maps of **a** – *Hapalopilus eupatorii*, **b** – *Erastia ochraceolateritia* in the Czech Republic and Slovakia. Grey circles denote records before 1970, red circles records since 2010. ▶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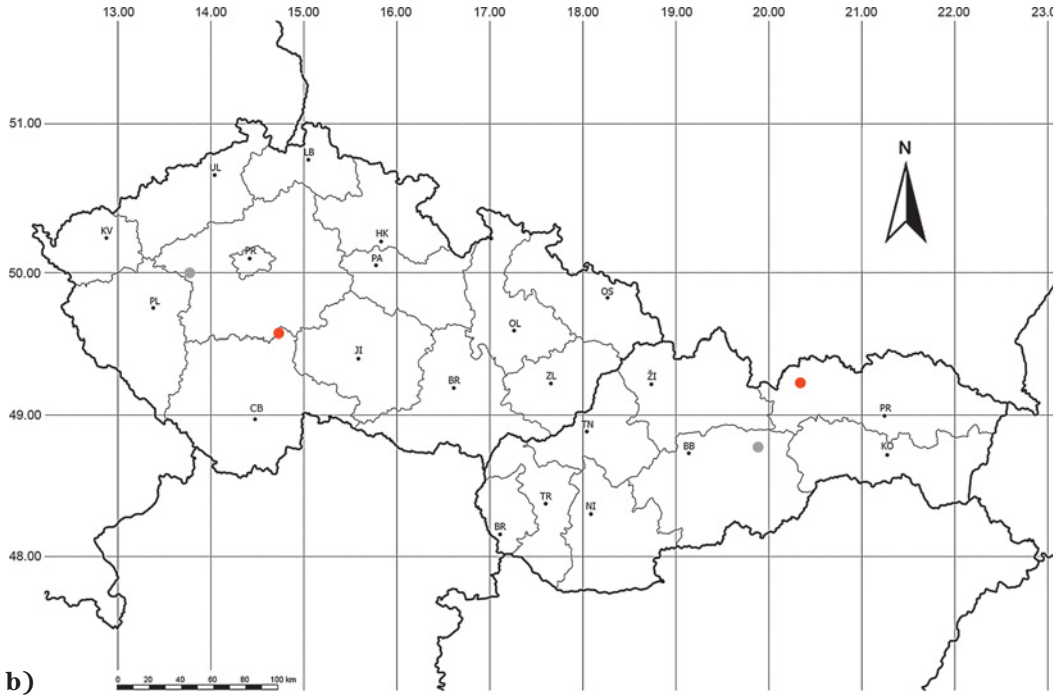
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b)

We found *Hapalopilus eupatorii* both on native (*Arctium* sp., *Frangula alnus*) and introduced (*Reynoutria* cf. *japonica*, *Wisteria sinensis*) plants in the Czech Republic. There is also an older specimen of A. Pilát from black locust (*Robinia pseudoacacia*) from the country. While *Reynoutria* (*Polygonaceae*; Dämmrich 2014), *Arctium* (*Asteraceae*; Fortey et Ryvarden 2007), *Robinia* (*Fabaceae*; Miettinen et al. 2016) were previously reported as substrate, *Wisteria* is a new one but confamilial with *Robinia*. In temperate Europe, *Hapalopilus eupatorii* could possibly also be found on other woody species of *Fabaceae* such as *Cytisus* and *Ulex*. Also robust herbs of other families, e.g. *Apiaceae* (e.g. *Angelica*, *Heracleum*), should be inspected. Our records from woody plants (*Frangula*, *Wisteria*) show that its substrate preference is considerably wider. Previously, it was mentioned from woody substrates (*Robinia*, *Clematis vitalba*) lying among *Reynoutria* stands, but it is clear that it can grow on woody substrate on its own. Nevertheless, in our specimens it was present on substrates of thin diameter (less than 3 cm), which was possibly not yet completely lignified.

Kotlaba (1984) did not mention any records of *Hapalopilus* from herbaceous plants nor from *Fabaceae* in former Czechoslovakia. We did not find any *Hapalopilus* specimens from herbaceous substrates in PRM. However, there were several specimens either from "atypical" substrates including *Robinia* or consisting of small resupinate basidiocarps. Unfortunately, during the revisions we found most of these specimens were almost to completely sterile preventing us from obtaining a sufficient set of measurements. An exception was A. Pilát's specimen from the town of Davle (PRM 807919), whose morphology, substrate and spore dimension agree well with *H. eupatorii*.

The preference of *Hapalopilus eupatorii* for introduced, even strongly invasive (*Reynoutria* cf. *japonica* and *Robinia pseudoacacia*) species in Europe is striking. While the *Reynoutria japonica* invasion is mostly a problem of the past decades in Europe, black locust was introduced in Europe much earlier, in the 17th century (Vítková et al. 2017). *Physisporus eupatorii* was originally described from an autochthonous plant host (*Eupatorium cannabinum*) in France (Karsten 1884) but much later than the introduction of *Robinia*. Therefore, it cannot be discounted that *Hapalopilus eupatorii* might have been introduced as well. Another hypothesis about the preference for alien plants is the growth form that many invasive plants share – robust tall herbs or fast-growing woody plants and the possible fine-tuning of enzymatic capabilities of *H. eupatorii* to such substrates.

Reynoutria japonica (and its hybrid *Reynoutria* ×*bohemica*) is an alien and invasive plant in Europe, including the Czech Republic (Pyšek et al. 2012), often forming dense monospecific stands. The resulting litter often decays slowly and accumulates. Despite its being an abundant source for decomposition by fungi, it is usually species poor in macromycetes – we have recorded only a few common

and non-specific species of basidiomycetes such as *Exidiopsis effusa* (Bref. ex Sacc.) Möller, *Lyomyces sambuci* (Pers.) P. Karst. or *Xylodon detriticus* (Bourdot) K.H. Larss., Viner et Spirin on this substrate.

All our records of *Hapalopilus eupatorii* in the Czech Republic were from more or less man-influenced habitats. This is not surprising, as sites where (including man-made) disturbance has taken place is where one would expect tall herb vegetation or habitats suitable for invasion of non-native plants such as *Reynoutria* and *Robinia*.

Erastia ochraceolateritia (Fig. 6b). Since the concept of *E. ochraceolateritia* was long unclear, its distribution is largely unknown. Both *E. ochraceolateritia* and *E. aurantiaca* as well as *Aurantiporus priscus* are very rare in Europe (Niemelä et al. 2012, Ryvarden et Melo 2017). Out of these, *E. aurantiaca* is the most frequent species in North Europe (Niemelä et al. 2012). According to Ryvarden et Melo (2017), *E. ochraceolateritia* is distributed in Denmark, Estonia, continental parts of Fennoscandia, Poland and Russia. There are also records from France (Rivoire 2020). It is a northern species not present in the Mediterranean area (Bernicchia et Gorjón 2020). During our revision of material in PRM, we also found one specimen from Germany (Lower Saxony, PRM 870916) and there is another record published from the same country (Saxony, DGfM on-line). Here we report this species from the Czech Republic and Slovakia for the first time.

According to Ryvarden et Melo (2017), *E. ochraceolateritia* grows on wood of conifers such as *Pinus* and *Picea*. Our data are in line with this. It is often hard to determine its hosts with certainty due to their advanced stage of decay. In the Czech Republic and Slovakia, *E. ochraceolateritia* seems to prefer stumps – both our recent specimens as well as the one by J. Herink[2] came from this substrate.

Despite of its scarce records, *E. ochraceolateritia* is not restricted to strongly natural habitats, at least not in central Europe. Our recent record from the Czech Republic is from a cultural conifer plantation; the recent one from Slovakia is from a protected area (Jedliny NR), but was found in a disturbed part where spruces had recently died (perhaps due to flooding).

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[2] Contrary to the herbarium label stating a strongly decayed trunk as the substrate, the orientation of tubes and the presence of a part of a cut surface indicates that the original substrate was in fact a stump.

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Erratum

In the online version of the article published March 26, 2021, the year 2020 erroneously appeared in the article citation on the title page. This version was withdrawn and the corrected version published online on March 30, 2021, being the official date of the online publication.

The publisher wishes to thank Jiří Kout for notifying the error. We apologise for this inconvenience.