ISSN (print) 0093-4666 ISSN (online) 2154-8889

MYCOTAXON

http://dx.doi.org/10.5248/119.217

Volume 119, pp. 217–231 *January–March 2012*

Four new polypore species from the western United States

Josef Vlasák[1,2*], Josef Vlasák Jr. & Leif Ryvarden[3]

[1]*Biol. Centre of the Academy of Sciences of the Czech Republic &*
[2]*University of South Bohemia, Faculty of Science,*
Branišovská 31, CZ-370 05 České Budějovice, Czech Republic
[3]*Biological Institute, P.O. Box 1045, Blindern, N-0316 Oslo, Norway*
*Correspondence to: *vlasak@umbr.cas.cz*

Abstract — Four new species of polypores are described from California, Oregon, and Washington, U.S.A. *Antrodia madronae,* seemingly confined to dead stems and branches of *Arbutus menziesii,* is closely related to European *Antrodia sandaliae* growing on *Arbutus unedo*. The generic position is evaluated for *Ceriporiopsis pseudoplacenta,* a strikingly colored species with many unique features that seems surprisingly common in the northwestern states. *Fuscoporia palomari* is distinguished from the similar *F. viticola* by much larger pores and spores. *Skeletocutis subodora* differs from *S. odora* by having thick subiculum, differently shaped basidiospores, abundant cystidioles, and no skeletal hyphae in the context. The nrDNA ITS region of all new species gave unique sequences in GenBank.

Key words — *Hymenochaetaceae, Phellinus, Phlebia,* ribosomal DNA, taxonomy

Introduction

The forested west coast of the United States is extremely biodiverse due to its varied topography, climate zones, and geology. The number of vascular plant species found in California exceeds the total number from the central and northeastern United States and adjacent Canada, an area ten times larger (CI 2007). The high degree of plant endemism is also striking; more than 61% of Californian plant species are found nowhere else in the world. This creates favorable conditions also for high diversity and endemism of wood-bound poroid fungi. Nevertheless, in the North American polypore monograph by Gilbertson & Ryvarden (1986, 1987), only 60 (of 406) species are specified as occurring in the western states of California, Oregon, and Washington. This indicates that the region still has a great potential for field research in polyporology.

Few substantial contributions have been published on USA west coast polypores since Murrill's early papers (Murrill 1912, 1915). Overholts, who

described several new species sent to him from the Pacific coast states, never collected in the far west (Overholts 1939). The same is essentially true for Lowe and other distinguished USA polyporologists. Gilbertson (1976, 1979), who published some new species and important distribution data, focused his research primarily on the dry hot regions of Arizona.

We visited various localities on the USA west coast and report here on several polypore collections. Although the collected material was quite scarce, we describe four new species supported by distinctive macro- and microscopic features and unique ITS rRNA sequences.

Materials & methods

Polypores were collected in August (2001, 2003), September (2005, 2009), and April (2010) during one-week trips to various localities in California, Oregon, and Washington (Vlasák 2008). The specimens were dried and microscopically inspected in Melzer's reagent (IKI) and 5 % KOH. Similar fungi from other parts of USA and Europe were also collected or loaned from herbaria and studied in detail as noted in 'Specimens studied.' All collected specimens are deposited in private herbarium of the first author, with types and some paratypes also in PRM. DNA isolation from critical samples, nr DNA ITS region sequencing, and comparative phylogenetic analyses methods follow Vlasák & Kout (2011). The evolutionary history was inferred using the Neighbor-Joining method (Saitou & Nei 1987) and phylogenetic analyses were conducted in MEGA4 (Tamura et al. 2007).

Taxonomy

Fuscoporia palomari Vlasák & Ryvarden, **sp. nov.** Plates 1–2

MycoBank MB 563062

Basidioma resupinatus vel effuso-reflexus, pori facies brunnea, rotundi vel elongati, 2 pro mm. Setae subulatae, brunnei, 40–75 × 5–8 µm, basidiosporae hyalinae, leves, cylindricae, 8–11 × 2.7–3.5 µm, inamyloideae, indextrinoideae.

Type: USA. California: Palomar Mt. State Park, 1500 m above see level, on oak log, 16 Apr 2010, J. Vlasák Jr. JV1004/5-J (**Holotype**, PRM 915982; **isotype**, JV1004/5a-J, GenBank JN592493).

Etymology: Referring to the type locality on Mt. Palomar, CA.

Basidiome about 7 × 5 cm, resupinate to effused-reflexed, with sharply delimited sterile margin 0.5–1 mm wide, pilei indistinct, projecting only 2–3 mm and ≤ 1 cm wide, upper surface tomentose, pore surface yellowish brown with a shiny luster when viewed obliquely. Pores large, circular to angular, in places somewhat labyrinthine, 2 per mm, with thin, soft dissepiments that are, though, often thickened on pore edges. Context brown, fibrous, rather soft, very thin in resupinate part but up to 2 mm thick in developing pilei; tube layer concolorous and continuous with the context, up to 3 mm thick. Contextual hyphae of two types, some brown in KOH, thick-walled, 2–4 µm in diam.,

Plate 1: *Fuscoporia palomari*. Basidiome.

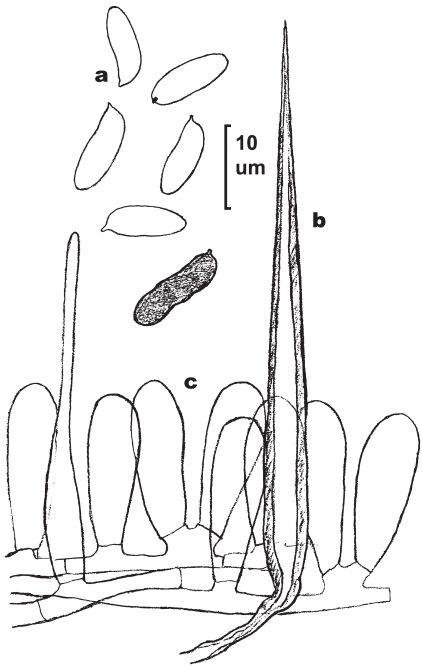

Plate 2: *Fuscoporia palomari* microscopic structures.
a: Basidiospores, b: Hymenial seta, c: Hymenium with basidia and cystidiole.

others hyaline in KOH, thin-walled, with occasional branching, simple-septate, 2–3 µm in diam.; tramal hyphae similar. Setae abundant, narrowly subulate,

thick-walled, very long, 40–75 × 5–8 µm, most of them around the upper length limit, protruding perpendicularly from the hymenium to more than a half of their length. Basidia clavate, simple-septate at the base, 15–25 × 5–8 µm. Cystidioles hyphoid, rarely present, with up to 25 µm long and about 1.5 µm broad terminal part. Basidiospores cylindric, straight, hyaline, thin-walled, smooth, IKI–, 8–10(–11) × 2.7–3.5 µm, few turning brown in KOH. Causing a white rot.

Comments — Only one juvenile basidiome with rudimentary developing pilei was collected. However, it shows many unique features: very large, hyaline cylindric spores, long setae, and large, shining pores. The hyaline basidiospores do not change in KOH except for a small fraction where the inner contents (not walls) turn deep brown. These usually have rather uneven walls and distorted shapes (Plate 2) that we consider atypical. The ITS nrRNA sequence is unique, showing significant similarity (max 93%) in GenBank Blast search only with *Fuscoporia viticola* (Schwein.) Murrill, a species with similar long setae and cylindric (but much narrower) basidiospores. *Fuscoporia sentifera* (T. Hatt.) Y.C. Dai, originally described from Japan (Hattori 1999) and recently reported in China (Dai 2010), is similar to *F. palomari* by resupinate to effused-reflexed basidiocarps, long hymenial setae, and cylindric spores but differs by a hispid pileal surface and smaller spores (5.8–7 × 2–2.5 µm).

Antrodia madronae Vlasák & Ryvarden, **sp. nov.** Plates 3–4

MycoBank MB 563081

Basidiomata annua, resupinata, nodulosa vel aliquando pileata, colore ligneo-pallens, pori rotundi vel elongati et sinuosi, 2–3 pro mm. Basidiosporae hyalinae, leves, tenuitunicatae, cylindraceae, 10–12 × 2.8–3.8 µm, inamyloideae, indextrinoideae. Cariem brunneam in ligno Arbuti menziesie *producet.*

Type: USA. Oregon: Oregon Caves entrance, on dead branch of pacific madrone tree, 14 Sep 2007, J. Vlasák Jr. JV0709/117-J (**Holotype**, PRM 899296; GenBank JN592494).

Etymology: Referring to the only known substrate tree, pacific madrone, *Arbutus menziesii* Purrs (*Ericaceae*).

Basidiomata annual, up to 30 × 10 cm, resupinate to effused-reflexed, nodulose or with narrow sloping pilei developed on a decurrent pore surface, individual pilei up to 4 cm wide, soft when fresh, upper surface ochraceous to light brown colored, coarsely rugose, azonate, margin sharp, tomentose, pore surface concolorous. Pores circular when immature, (1–)2(–3) per mm, on sloping parts often sinuous and elongated; dissepiments thick. Context thin and about the same color as the pore surface, tube layer concolorous, up to 7 mm thick. Hyphal system dimitic, generative hyphae clamped, branched, thin-walled or somewhat thick-walled, 2–4 mm in diam., dominating in all parts of basidiocarp, thickened walls gelatinizing and dissolving in KOH,

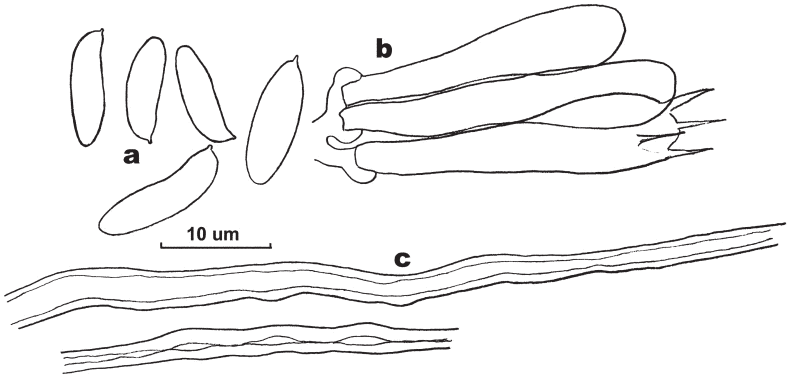

Plate 3: *Antrodia madronae* microscopic structures.
a: Basidiospores, b: Basidia, c: Skeletal hyphae.

Plate 4: *Antrodia madronae*. Basidiome (JV0709/90).

skeletal hyphae thick-walled but never solid, 3–5 µm in diam., dissolving in KOH. Cystidia none. Basidia narrowly clavate, with four sterigmata and a basal clamp, 25–40 × 6–8 µm. Basidiospores hyaline, thin-walled, smooth, IKI–, cylindrical or somewhat fusiform, 10–12 × 2.8–3.8 µm. Causing a brown rot on dead branches and stems of pacific madrone.

Additional specimens examined: ***Antrodia madronae*** – **USA**. **California**: Crescent City, Myrtle Creek, on dead stem of *Arbutus menziesii,* 12 Sep 2007, J. Vlasák (JV0709/90). ***Antrodia sandaliae*** – **ITALY**. **Sardinia**: Montarbu Forest, Sarolegne,

Arbutus unedo, 29 Nov 2003, A. Bernicchia (HUBO 7803, GenBank JN592495); 29 Nov 2003, A. Bernicchia (HUBO 7784, ITS sequence is identical with that of HUBO 7803); 24 Nov 1999, A. Bernicchia (HUBO 7340).

Comments — More material is needed to describe the extent of macroscopic variation of this species. The description is based on only two specimens; the type is a small, resupinate basidiocarp in the wood-crevice of a dead, broken branch of a living tree, while the other, growing on a dead standing tree, is a large, partly pileate basidiocarp with a strikingly rugose pileus surface but old and heavily damaged by insects (Plate 4). *Antrodia madronae* is characterized by large cylindrical basidiospores, rather soft fruitbodies dominated by generative hyphae, extremely soft trama that almost dissolved during the microscopic preparation in Melzer's reagent, large pores, and causing a brown rot. Undoubtedly, the fungus is closely related to the Mediterranean *A. sandaliae* Bernicchia & Ryvarden, also growing on an arbutus (*Arbutus unedo* L.) and characterized by a white pulvinate basidiome, similar soft trama and hyphal system, and similarly shaped but smaller basidiospores (7.5–10.0 × 1.8–3.0 µm; Bernicchia & Ryvarden 2001, Gorjón & Bernicchia 2009). Although both species have KOH-soluble thick-walled hyphae, the pores, basidia and spores of *A. madronae* are distinctly larger and the basidiome is varicolored.

Sequence analysis — The amplified ITS1-5.8S-ITS2 rDNA region of *A. madronae* was 565b long between ITS1 and ITS4 primer sequences (White et al. 1990) and the sequence was rather similar to that of *A. sandaliae* HUBO 7803 and HUBO 7784. The sequence variation between *A. madronae* and *A. sandaliae* of 2.0% (4/199) in ITS1 and 2.4% (5/212) in ITS2 suggests a very close relationship regardless of the pronounced macroscopical differences. Other species in GenBank Blast Search are only distantly related, with *A. albobrunnea* (Romell) Ryvarden (max. 83% sequence similarity) seemingly the closest.

Ceriporiopsis pseudoplacenta Vlasák & Ryvarden, **sp. nov.** Plates 5–8

MycoBank MB 563082

Basidiomata annua, resupinata, salmon pink pallide colore sed carnosa et cartilaginea post siccatione, deinde rubro-brunnei colore. Pori rotundi vel angulati, 3–4 pro mm. Systema hypharum monomiticum, hyphae hyalinae, fibulatae, ramosae, 2.0–3.0 µm latae, quae materiam oleaceam continent. Basidiosporae hyalinae, leves, ellipsoideae, 3.5–4.5(–5) × 2.2–3 µm.

Type: USA. Washington: Forks, Bogachiel State Park, 6 Aug 2003, *Picea sitchensis* (Bong.) Carrière. log, J. Vlasák JV0308/68 (**Holotype**, PRM 899297; **isotype**, JV0308/68a; GenBank JN592496, JN592497, JN592504).

Etymology: from the Latin for false placenta, based on the superficial similarity with *Postia placenta*.

Basidiomata annual, resupinate, up to 20 × 10 cm, soft when fresh, tough and fleshy when dry, and soaked with resinous substance, not readily separable;

Plate 5: *Ceriporiopsis pseudoplacenta*. Basidiome in situ (JV0709/54).

pore surface pale apricot to salmon-pink when fresh, exuding white drops, turning up dark reddish brown on drying. Pores circular to angular, 3–4 per mm, with thick, entire dissepiments that finally become thin and lacerate; margin narrowly sterile but sometimes up to 15 mm broad in actively growing stage, whitish at first, later pale apricot, on drying dark reddish brown to black and often peeling off. Context pale orange-pinkish when fresh, blackish when dry, less than 1 mm thick; tube layer pale salmon-pink, up to 5 mm thick. Hyphal system monomitic, hyphae hyaline, thin-walled, often branched, 2–4 μm in diam., with abundant, often closely spaced clamps. In Melzer's reagent, the hyphae are covered by small oil drops that often fuse into large, brownish, oily blotches; in KOH the hyphae are stripped of the oily matter that forms irregular, brown aggregates in the tissue. Cystidia none. Basidia inconspicuous, not much broader than hyphal ends, thin-walled, narrowly clavate, 4 -sterigmate, with a basal clamp, 15–25 × 4–5 μm,. Basidiospores broadly ellipsoid, distinctly narrowing to the apex in most cases, hyaline, thin-walled, smooth, IKI–, 3.5–4.5(–5) × 2.2–3 μm. On rather rotten logs of various coniferous trees. White rot.

Additional specimens examined: ***Ceriporiopsis pseudoplacenta*** – **USA**. **Washington**: Hoh River, conifer log, 6 Aug 2003, J. Vlasák (JV0308/61, PRM 899298, ITS sequence identical with JN592497); **California**: Kings Canyon Nat. Park, 12

Plate 6: *Ceriporiopsis pseudoplacenta*. Basidiome in situ (JV0709/53).

Aug 2001, conifer log, J. Vlasák (JV0108/82A, PRM 899299); Crescent City, Jed Smith State Park, Simpson Grove, hemlock, 8 Sep 2007, J. Vlasák (JV0709/53, PRM 899300, GenBank JN592498, JN592505); 8 Sep 2007, J. Vlasák (JV0709/54); **Tennessee**: Great Smoky Mt., Gregory Ridge Trail, hemlock, Sep 2005, J. Vlasák (JV0509/52, GenBank JN592499, JN592506). ***Auriporia aurea*** – **USA**. California: Sequoia Nat. Park, Wolverton Area, *Abies magnifica* A. Murray log, 14 Sep 2001, J. Vlasák (JV0109/92, PRM 915966, GenBank GU595152). ***Auriporia aurulenta*** – **CZECH REPUBLIC**. Red Marsh Nat. Preserve, *Pinus sylvestris* L., 25 Oct 2009, J. Vlasák (JV0910/12, PRM 915967, GenBank GU595153). ***Ceriporiopsis* sp.** – **USA**. **Florida**: Everglades Nat. Park, Long Pine Key, 20 Apr 2009, *Pinus elliottii* Engelm., J. Vlasák (JV0904/46, GenBank JN592500, JN592507). ***Postia placenta*** – **USA**. **New York**: Upper Jay, Adirondacks Park, *Pinus* sp., 20 Sep 2005, J. Vlasák (JV0509/174, GenBank JN592502); **California**: Yosemite Nat. Park, Tuolumne Grove, *Pinus lambertiana* Douglas, 17 Aug 2001, J. Vlasák (JV0108/98, GenBank JN592501). **SLOVAK REPUBLIC**: Dobroc Virgin Forest, 21 Sep 2009, *Picea abies* L. (H.Karst.), J. Vlasák (JV0909/16, GenBank JN592503).

Comments — *Ceriporiopsis pseudoplacenta* is probably widely distributed in the western USA, as we found it in various locations during every trip to California and Washington (Vlasák 2008). One specimen comes also from the Great Smoky Mt., Tennessee. It is difficult to understand why this strikingly colored fungus has not previously been described, yet we found nothing similar in the literature. In the field, *C. pseudoplacenta* can be mistaken for *Auriporia aurea* (Peck) Ryvarden or *Postia placenta* (Fr.) M.J. Larsen & Lombard because

Plate 7: *Ceriporiopsis pseudoplacenta*. Basidiome in situ (JV0509/52).

of similar colors and soft, fleshy consistency. *Auriporia aurea* (and the similar European *A. aurulenta* A. David, Tortič & Jelić) differ by having skeletal hyphae and thick-walled cystidia. *Postia placenta* is difficult to separate by microscopy alone because both species have similar hyphal system with no special structures and similar spores that are, however, smaller in *C. pseudoplacenta.* Macroscopical differences are more distinctive, especially when monitoring basidiome changes during development and drying. *Postia placenta* starts growing usually as a deep-red basidiome, changing to rosy-pink and, when old or dry, to whitish-pink or light ochre. *C. pseudoplacenta* follows just the opposite coloration steps; it starts as whitish or light salmon pink, becoming increasingly more deeply red until maturing to red brownish or black in the subiculum and margin. Also, the consistency of dried fruitbodies is quite different: soft and brittle in *P. placenta* but tough and rubber-like (reminiscent of beef jerky) in *C. pseudoplacenta*. *Auriporia aurea, A. aurulenta,* and *P. placenta* cause a dry brown rot. The wood under *C. pseudoplacenta* basidiomes is usually also quite dark as the fungus causes some red-brownish wood coloration, but its stringy fibrous structure with small pockets corresponds more to white rot. Unfortunately, we did not perform oxidase tests on fresh fruitbodies. *Ceriporiopsis gilvescens* (Bres.) Domański, a white rot polypore, also sometimes resembles *C. pseudoplacenta,* but its salmon-pinkish colours are usually

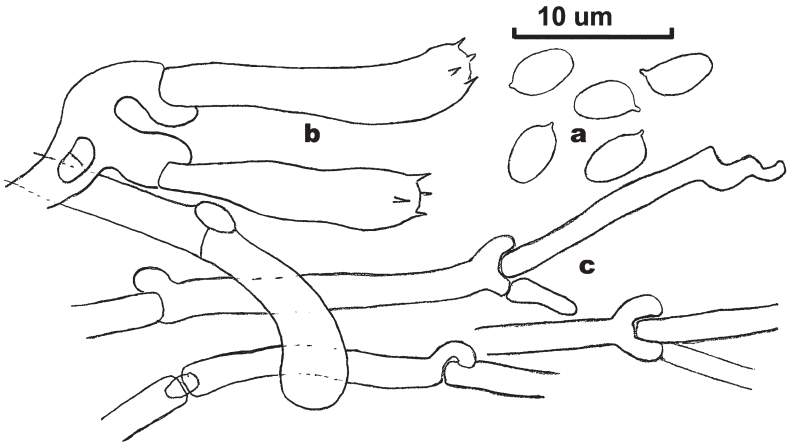

Plate 8: *Ceriporiopsis pseudoplacenta* microscopic structures.
a: Basidiospores, b: Basidia, c: Hyphae.

paler and the spores are narrower (1.5 – 2 µm). *Antrodiella albocinnamomea* Y.C. Dai & Niemelä, widely distributed in Asia (Dai & Niemelä 1997; Dai 2012), is macroscopically similar to *C. pseudoplacenta*, but differs in its dimitic hyphal structure and oblong-ellipsoid spores (3.7–5 × 2.1–2.9 µm).

The taxonomic position of *C. pseudoplacenta* is a mystery, as the sequence analysis (see below) revealed very low homology with known fungi. So we chose for it the congregate genus *Ceriporiopsis* Domański that encompasses white rot species that are poroid, resupinate, and monomitic with clamp connections.

Sequence analysis — Successful amplification and sequencing of the *C. pseudoplacenta* ITS (nrDNA) region from four of six collected specimens showed only minor differences between individual specimens (Plate 9). 5.8S rDNA is highly homologous with many other polypores, but for the very long ITS1 region (280-283b) the GenBank MegaBlast search found "no significant similarity," which we never experienced before for polypore species. ITS2 analyses indicate very low similarity with seemingly distant fungi, with *Ceriporiopsis* species showing the closest support among the polypores. Sequence analyses weakly support clustering of *C. gilvescens* with *C. pseudoplacenta,* and apart from the brown-rot fungi *Postia* Fr., *Auriporia* Ryvarden and *Antrodia* P. Karst. in a separate clade (Plate 9). Some *Phlebia* Fr. species, macroscopically similar except for the hymenophore form, cluster even more closely with *C. pseudoplacenta*, as also shown in the nrDNA LSU sequence analyses (Plate 10). For the time being, the generic position of the new species must be regarded as provisional.

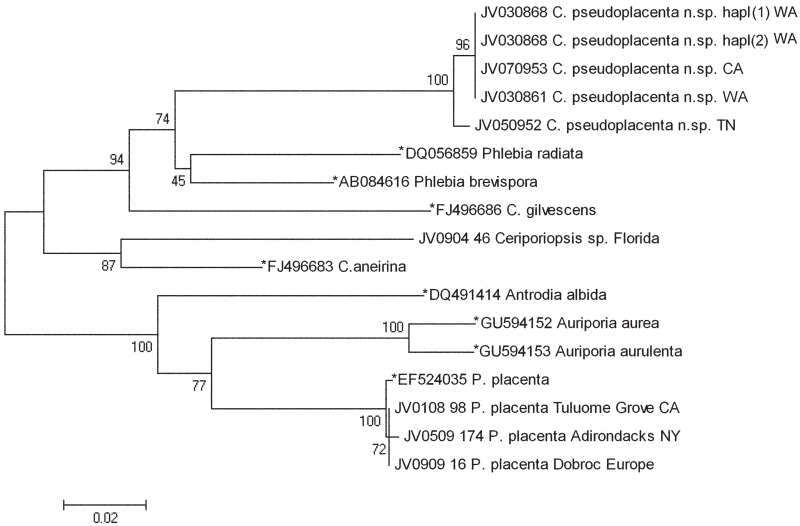

Plate 9. Evolutionary relationships using the Neighbor-Joining method of 16 *Antrodia*, *Auriporia*, *Ceriporiopsis*, *Phlebia,* and *Postia* specimens based on nr DNA ITS region sequence. The bootstrap consensus tree inferred from 1000 replicates is taken to represent the evolutionary history of the taxa analyzed. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) is shown next to the branches. The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree. The evolutionary distances are in the units of the number of base substitutions per site. Accession numbers with * represent sequences retrieved from GenBank. All other GenBank accession numbers refer to new sequences listed in this paper.

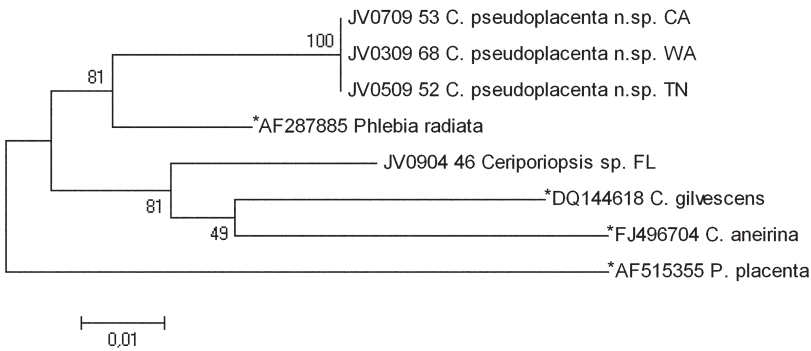

Plate 10. Evolutionary relationships of 8 *Ceriporiopsis*, *Phlebia* and *Postia* specimens based on nrDNA LSU region sequence. Phylogenetic analysis as referred in pl. 9.

Another *Postia placenta*-like specimen (JV0904/46, Plate 9) we have collected in early spring from the tropical region of southern Florida from slough pine (*Pinus elliottii*) is morphologically very similar to *P. placenta* or *C. pseudoplacenta* except for slightly shorter spores, but its sequence is more similar to *Ceriporiopsis aneirina* (Sommerf.) Domański. We need additional material before resolving the identity of this specimen.

Skeletocutis subodora Vlasák & Ryvarden, **sp. nov.** Plates 11–13

MycoBank MB 563083

Basidiomata annua, resupinata, usque ad 10 cm lata et 1 cm spissa, colore albicante, pori rotundi vel angulati, 3–5 pro mm, contextus albus, 1–4 mm crassus. Systema hypharum monomiticum, hyphae fibulatae, cystidioli hyalinni, fusiformes, basidiosporaes hyalinae, leves, tenuitunicatae, non amyloideae, non dextrinoideae, 5–6 × 2.0–2.3 µm.

Type: USA. Oregon: Crater Lake visitors center, *Pseudotsuga menziesii* (Mirb.) Franco log, 15 Sep 2007, J. Vlasák JV0709/134 (**Holotype**, PRM 899301; **isotype**, JV0709/134a, GenBank JN592509).

Etymology: From the Latin for *odora*-like, referring to the similarity to *S. odora*.

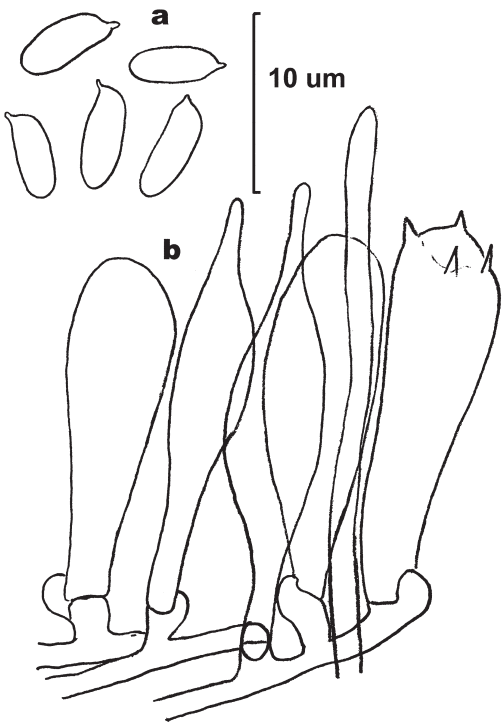

Plate 11. *Skeletocutis subodora* microscopic structures.
a: Basidiospores, b: Hymenium with basidia and cystidioles.

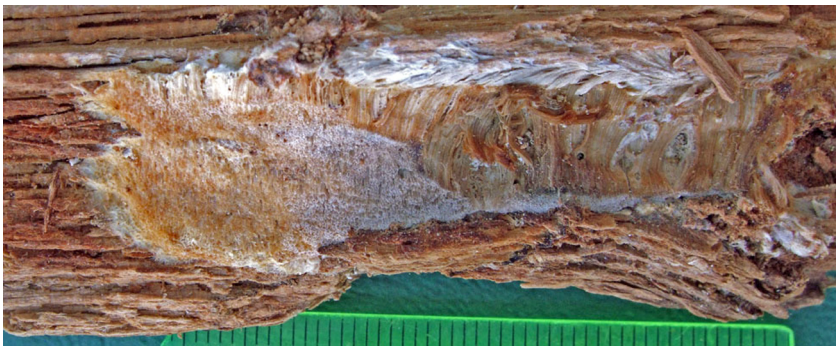

Plate 12. *Skeletocutis subodora*. Basidiome (PRM 899301, holotype)

Basidiomata annual, resupinate, found in two patches effused to 5 × 5 and 10 × 10 cm, up to 1 cm thick, soft when fresh, no odor noted, drying brittle and shrinking; sterile margin 1–3 wide, well demarcated, whitish, tawny on drying; pore surface cream-colored, drying pale beige. Pores at first regular, 3–5 per mm, with very thin dissepiments, on drying becoming more dented and more irregular. Subiculum white to pale cream, 1–4 mm thick; tube layer concolorous with pore surface, resinous and compressed when dry, distinctly ochre-colored compared with the white subiculum, up to 8 mm thick. Hyphal system monomitic, hyphae hyaline, thick to thin-walled, often branched, with clamps, 2–4 µm in diam., their ends on dissepiments edges sparingly incrusted by sharp crystals. Cystidial elements as fusoid cystidioles abundant and conspicuous, thin-walled, with a basal clamp, 15–25 × 2–6 µm. Basidia clavate, 4-sterigmate, with a basal clamp, 15–20 × 5–6 µm. Basidiospores narrowly ellipsoid to cylindrical, hyaline, thin-walled, smooth, IKI–, 5–6 × 2–2.3 µm. On decorticated log of Douglas fir, causing a white pocket rot.

Additional specimens examined: ***Ceriporiopsis guidella*** – **ITALY**: Ris. Di Sasso Frantino, Rio Cullacce (Forli), *Acer* sp., 22 Sep 2001, A-R. Bernicchia (coll. 7731). ***Skeletocutis diluta*** – **USA. Florida**: Everglades Nat. Park, Long Pine Key, *Pinus elliottii*, 29 Aug 2010, J. Vlasák (collection JV1008/61, PRM 899302, GenBank JF692198). ***Skeletocutis odora*** – **CZECH REPUBLIC**. Zofin Nat. Preserve, *Picea abies* log, 22 Jul 2010, J. Vlasák (JV1007/7, GenBank JN592509).

Comments. The fungus was collected as a probable *Skeletocutis odora* (Sacc.) Ginns, which is actually very similar macroscopically and with a sequence that shows a high degree of homology (see below). The most important macroscopical diagnostic feature is the thick (≤ 2–4 mm) subiculum, barely 1 mm thick in *S. odora*. The distinctive (relatively broad non-allantoid) basidiospores, conspicuous large cystidioles, and monomitic context also distinguish *S. subodora*. The macroscopically similar *Ceriporiopsis guidella* Bernicchia & Ryvarden (Bernicchia & Ryvarden 2003) also produces similar

cystidioles and spores but differs in an extremely thin subiculum, growth on hardwoods, and different ITS nrRNA sequence (see below).

Thus far the new species is known only from the type locality, although the occurrence of the similar *Skeletocutis odora* in the USA warrants mention. Lowe (1966) stated that *S. odora* is known with certainty only from Peck's type and one other report from Pennsylvania, while Gilbertson & Ryvarden (1987) do not cite the species at all from the USA. We also never found *S. odora* during numerous excursions in either the east or west USA, although it is not uncommon in old-growth conifer forests in Europe.

Sequence analysis — The amplified ITS1-5.8S-ITS2 sequence from *Skeletocutis subodora* (603b long between ITS1 and ITS4 primers) was somewhat similar (variations of 3.0% (6/195) for ITS1 and 4% (8/205) for ITS2) to that of *S. odora* (Plate 13), suggesting that the two species are related to but different from each other. Surprisingly, *Tyromyces chioneus* (Fr.) P. Karst., with a still unsettled taxonomic position, shows surprisingly more homology than other *Skeletocutis* species.

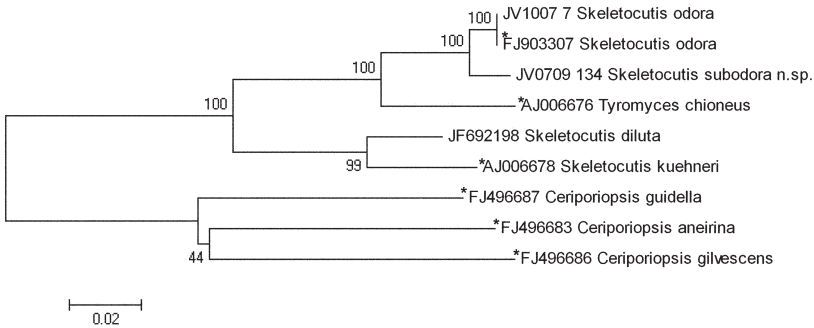

Plate 13. Evolutionary relationships of 9 *Skeletocutis* and *Ceriporiopsis* specimens based on nr DNA ITS region sequence. Phylogenetic analysis as referred in pl. 9.

Acknowledgements

Sergio Pérez Gorjón and Yu-Cheng Dai have kindly acted as presubmission reviewers and their help with text improvement is acknowledged. We are grateful also to Petr Vampola for checking the microscopic inspection results and valuable comments. This research was supported by CEZ:AV0Z50510513 fund.

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