

MYCOTAXON

Volume 102, pp. 415–424

October–December 2007

A new polypore *Irpex cremicolor* described from North Europe

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Abstract — *Irpex cremicolor*, a poroid basidiomycete, is described as new based on collections from old-growth forests in northern Finland and Norway. It is characterised by a resupinate habit, lacerate pores, and a dimitic hyphal system. Most of the septa are simple, but scattered clamps are present. The species reminds of the North American *Oxyporus similis*, which is re-described and compared to the closely reminiscent *O. obducens*. These two are often considered synonyms, but they are kept separate here on account of minor differences in their hyphal and spore characteristics.

Key words — *Irpex lacteus*, *Oxyporus populinus*, *O. schizoporoides*, *Polyporaceae*, taxonomy

Introduction

Basidiomycetes of North Europe have been studied for over 200 years, and they are among the best known globally. Polypores belong to the intensively investigated groups of the basidiomycetes, about 255 polypore species being known from Finland, Norway and Sweden (Ryvarden et al. 2003, Niemelä 2005, Fungus Info 2007). Anyhow, species new to science are found from this area almost annually, and not only through splitting of old taxa.

One such distinctive new species is described here based on three specimens collected within the last ten years. The collections were made during polypore inventories. For an experienced collector, the species does not readily remind of other polypores known from this area when observed with the naked eye and even less so microscopically. The two Finnish collectors, Matti Kulju and Mariko Lindgren, were struck by the odd combination of characters of their

specimens that did not fit to any of the known species. Thus the specimens were sent to the Botanical Museum of the University of Helsinki (H) for further scrutiny. Also the third collection from Norway by Gunnar Kristiansen was similarly forwarded to the University of Oslo (O).

The new species with its dimittic, nearly clampless hyphal structure, club-like and eventually thick-walled cystidia, and thin-walled spores is currently best placed in the genus *Irpex* Fr. According to POLYPORES OF NORTH AMERICA (Gilbertson & Ryvarden 1986, 1987), the new species keys out as *Oxyporus similis*, a North American taxon with uncertain delimitation towards the European species *Oxyporus obducens* (Pers.) Donk. We provide a description of *O. similis* as well, based on authentic material, and a comparison between the three species.

Materials and methods

During microscopic studies the basic mountant medium used was Cotton Blue (CB), but also Melzer's reagent (IKI) and 5% KOH was used. Spore and other measurements were made and illustrations were drawn in CB. Entry CB+ means cyanophily, CB(+) weak but distinct cyanophilous reaction, CB- acyanophily; IKI- means neither amyloid nor dextrinoid reaction; KOH- means that hyphae were left almost unchanged. Measurements were done using $\times 1000$ or $\times 1250$ magnification and phase contrast illumination; eyepiece scale bar with 1- μm -grid was used, and dimensions were estimated subjectively with an accuracy of 0.1 μm (see Miettinen et al. 2006 for further detail).

The following symbols are used for spore measurements: L = mean length, W = mean width, Q = L/W, i.e. average length divided by average width, Q' = length/width ratio of individual spores, n = number of spores measured from given number of specimens, for instance 90/3 means 90 spores measured from 3 specimens. In presenting the variation of spore size and Q', the whole range is given in parentheses. The 90% range excluding the extreme 5% of values from both ends is given without parentheses. In case the 5% limit falls between two values, the one further from the median was chosen to represent the 5% tail. Whenever the figures within and outside parentheses are identical, parentheses are omitted.

Species description

Irpex cremicolor Miettinen, Niemelä & Ryvarden, sp. nov.

Fig. 1

Mycobank MB505111

Basidioma resupinatum, cremeo-album, poris laceritis, 2–4 per mm. Systema hypharum dimitticum, hyphis efibulatis; cystidia clavata, basidiosporae ellipsoideae, tenuitunicatae, 3.8–5 \times 2.4–3.2 μm .

HOLOTYPE—Norway. Nord-Nordland: Narvik, Prestjord, riverine deciduous natural forest, on *Alnus incana*, 15.X.1999 G. Kristiansen (O, isotype H).

ETYMOLOGY—*Cremicolor* (Lat.): cream-coloured, referring to the colour of the basidiocarps.

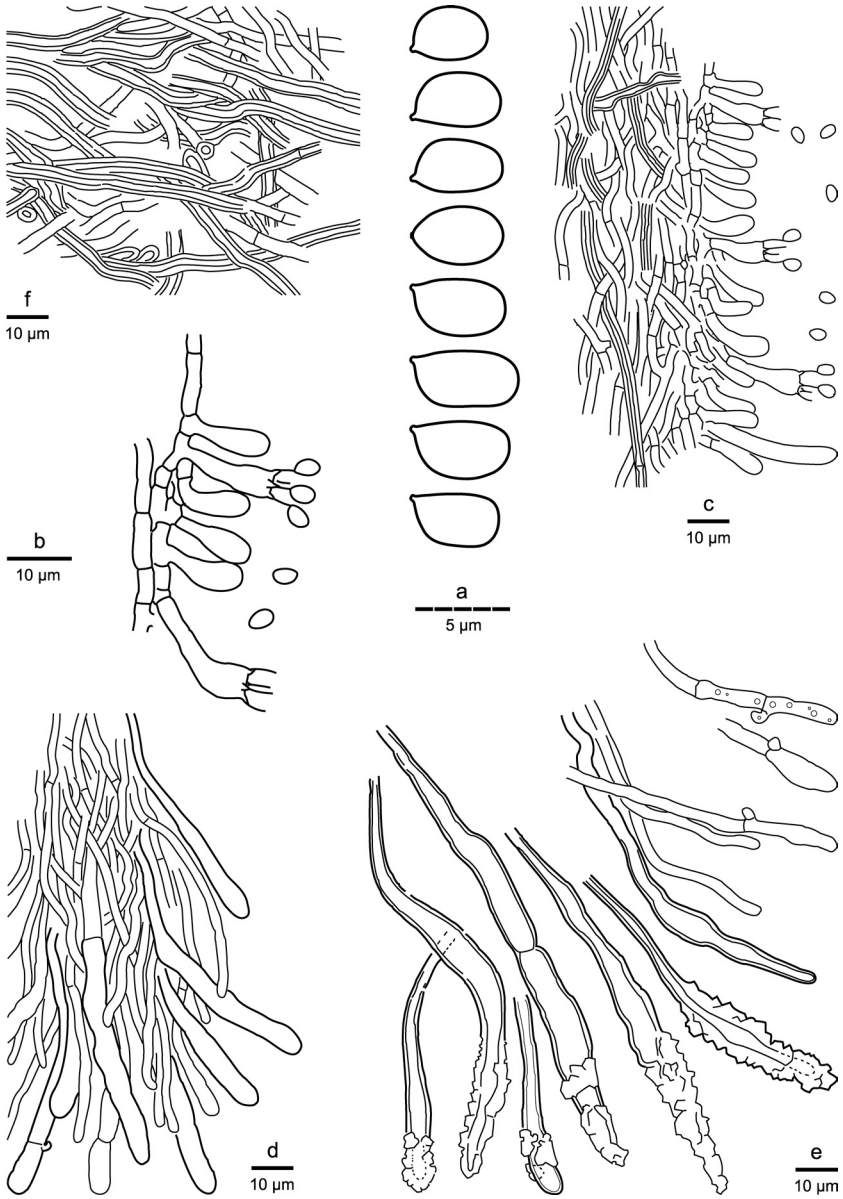


Fig. 1. *Irpex cremicolor*, a) spores, b) hymenial cells, c) tube trama and hymenium, d) hyphae from young tube orifices with juvenile cystidia e) hyphae from tube orifice, mature basidiocarp: cystidia, regular hyphae and hyphal tips with clamps, f) subiculum from mature basidiocarp.

Drawn from isotype, except d) from Kulju 1004.

Basidiocarp resupinate, pure white to cream-coloured in older parts and when dry, size in the magnitude of 10 cm² or larger, 1–4 mm thick. Tubes rather thin-walled, soon splitting, approaching lacerate, orifices irregular, tube layer 1–3 mm thick; pores labyrinthine, 2–4 per mm. Subiculum of the same colour, 0.2–2 mm thick. Margin thin, irregular but sharply delimited, sterile part typically several to ten millimetres wide, sometimes almost rhizomorphic.

Hyphal system dimitic, skeletal few in young basidiocarps but in old specimens dominating throughout except at tube mouths. Distinction between generative and skeletal hyphae is indistinct particularly in subiculum, where intermediary hyphae, i.e. thick-walled but branching and septate, occur. The dimitic structure is clearest in the upper tube trama. Hyphae slightly amyloid in mass, CB(+) to CB–, part of the generative and skeletal hyphae swelling noticeably in KOH. Generative hyphae thin- to slightly thick-walled, (1.8–)2.2–3.4(–5) µm in diameter, clamps mostly absent but rare scattered clamps found throughout the basidiocarp, most frequently close to tube mouths. Subicular skeletal somewhat twisted, occasionally branched, (2.2–)2.6–3.6(–5) µm, (2.5–)3.6–5(–5.8) µm in KOH, with a clear lumen, in mature skeletal a third or less of the width. Tramal skeletal similar, interwoven to subparallel, (2–)2.5–3(–3.7) µm.

Cystidia common, thin- to thick-walled, long tubular and slightly constricted, with a wide lumen and occasional septa at lower parts, born deep in trama, occasionally projecting through tube mouths and hymenium, old cystidia encrusted in the apical part with crystal lumps, (35–)60–170×(5.4–)6–8(–13.5) µm excluding encrustation, up to 16 µm wide if measured with crystals. The cystidia are born on generative hyphae. In subiculum there are embedded, cystidia-like, partially swollen hyphae, occasionally branched and sometimes bearing similar encrustation as in tramal cystidia. They have clearly similar origin, but unlike the cystidia in trama, which are always terminal cells of hyphae, some of the subicular cystidia are long, swollen, thick-walled intercalary sections in the middle of normal hyphae, i.e. not terminal. Prominent, thick-walled cystidia appear rather late in the development of the basidiocarps; before maturing they appear as thin-walled, swollen terminal hyphae at tube mouths.

Hymenium. Basidia cylindrical to clavate, 11–16(–23)×4–5.5(–6) µm, usually with 4 sterigmata but occasionally with 1 or 2, mostly without a basal clamp, but a few seen on basidioles so probably also basidia are occasionally clamped. Cystidioles not present.

Basidiospores ellipsoid, thin-walled, smooth, CB–, IKI–, (3.6–)3.8–5(–5.9) × (2.3–)2.4–3.2 µm, L=4.25 µm, W=2.67 µm, Q'=(1.3–)1.4–1.8(–2.0), Q=1.59, n=120/3.

Distribution. The three collections all originate from the northern and middle boreal zones (Ahti et. al. 1968) in Northwest Europe (Finland and Norway).

Ecology. The Norwegian specimen was collected from *Alnus incana* whereas the Finnish specimens are from *Betula pubescens* decayed by *Phellinus igniarius* (L.) Quél. coll. It is possible that the species is a successor (cf. Niemelä et al. 1995) of *Phellinus* spp., but this has to be confirmed. All the collections derive from moist, mesic sites, in natural or semi-natural deciduous or spruce-dominated old-growth forests in landscapes with a rather high percentage of natural forests. The species might well be an old-growth forest specialist.

Remarks. *Irpex cremicolor* has an unusual combination of characters for a polypore. Its hyphal system could be described as dimitic with somewhat unclear distinction between generative and skeletal hyphae. In young basidiocarps (Kulju 1004, Lindgren 9849) most of the hyphae are fairly thin-walled, but wall thickness increases with age and finally thick-walled hyphae dominate (type). Also the thick-walled cystidia develop late, bearing only sparse encrustation if any.

The most peculiar feature is the partial formation of clamps in the basidiocarps, seen in all three specimens. Scattered clamps are known to occur in predominantly clampless polypores (e.g. *Flabellophora*, *Heterobasidion*), hydneaceous fungi (*Hydnellum*) and in several genera of corticioid basidiomycetes (e.g. *Athelia*, *Coniophora*, *Phanerochaete*), but such intermediary cases are nevertheless a small minority. A large number of clamps in *I. cremicolor*, perhaps majority, are somehow malformed, either abnormally swollen and septate, or looking as if the development of clamp had ceased prematurely in the middle, before anastomosis. In such cases, the clamp has not merged with the adjoining previous cell as supposed to, i.e. the clamp is left as an open, backward-pointing hook, even though clearly identifiable as a clamp (Fig. 1).

These characters, together with resupinate habit and thin-walled spores define the species from other slightly similar ones in *Irpex*, *Oxyporus* and *Rigidoporus*. Pertinent keys would place *I. cremicolor* close to *Oxyporus similis*. Both share the resupinate habit, similar-sized pores, encrusted cystidia and thin-walled, ellipsoid spores. Closer scrutiny shows that *O. similis* is distinctly monomitic without any clamps at the septa, its cystidia are shorter and much more heavily encrusted, and its spores are slightly broader than in *I. cremicolor* (Tab. 1). The pores of *O. similis* are regular as opposed to lacerate, and smaller than those of the new species. *Oxyporus obducens* is very similar to *O. similis*, and differences to *I. cremicolor* hold also for that species.

Oxyporus schizoporoides Zmitr. & Spirin was recently described from Northwest Russia. The species is probably a synonym of *O. obducens* with which it shares such essential characters as monomitic hyphal structure, short encrusted cystidia, and cyanophilous, small spores (Tab. 1). *Oxyporus schizoporoides* does not have truly split tubes, and the above mentioned microscopic characters are not shared with *I. cremicolor*.

Oxyporus spiculifer (G. Cunn.) P.K. Buchanan & Ryvardeen from New Zealand has lacerate tubes of roughly the same pore size (1–2 per mm) as *I. cremicolor* (Cunningham 1965, Buchanan & Ryvardeen 1988). *Oxyporus pellicula* (Jungh.) Ryvardeen from Java has often lacerate tube orifices as well. Both species have a monomitic hyphal structure with heavily encrusted cystidia unlike *I. cremicolor*.

Irpex lacteus (Fr.) Fr. differs from *I. cremicolor* in being usually pileate and by the nature of its cystidia which are more finely and heavily encrusted, and by its longer, curved cylindrical spores (5.8×2.5 µm in average, Tab. 1).

Finally, the appearance of *I. cremicolor* with its almost rhizoid margin and similar-sized, somewhat lacerate tubes may bring in mind *Junghuhnia lacera* (P. Karst.) Niemelä & Kinnunen. These two species share the dimitic hyphal structure and both bear encrusted cystidia. Generative hyphae of *J. lacera* always bear clamps at septa, cystidia are carrot-shaped rather than cylindrical, and spores are subglobose.

Oxyporus similis (Bres.) Ryvardeen, Persoonia 7:20, 1972.

Basionym: *Poria similis* Bres., Mycologia 17:76, 1925. Lectotype: USA. Idaho: Bonner County, Coolin, on *Populus trichocarpa*, 18.IX.1919 Weir US242516 (BPI, studied). Selected as type by Lowe (1966:21).

Basidiocarp resupinate, pore surface straw-coloured, contrasting with the white margin, patches from 10 cm² to at least the size of a palm, 0.2–2(–3) mm thick. Consistency rather tough when dry. Pores regular, thin-walled, 4–6 per mm, tube layer up to 2 mm thick. Subiculum cream-coloured, but towards substratum turning into a brownish, woolly basal layer, usually just a thin line. Margin sharply delimited, thinning out, sterile part 0.5–0.2 mm wide.

Hyphal system monomitic, hyphae rather uniform throughout the basidiocarp, yellowish in mass, CB(+), IKI–, KOH–, commonly septate, clamps absent. Subicular hyphae thick-walled, (2.2–)3.2–4(–5) µm, with a wide lumen and walls up to 1 µm thick. Tramal hyphae thin- to slightly thick-walled, parallel to subparallel, tissue rather dense, (2–)2.5–3.2(–4.2) µm.

Cystidia abundant in trama, clavate, projecting through hymenium, heavily encrusted, 20–40(–70)×(5.5–)7.5–10(–13) µm, including crystal cover. Young cystidia thin-walled, apically encrusted hyphal ends, older ones eventually thick-walled. They are born in trama or subhymenium but bend through hymenium, occasionally projecting a little.

Hymenium. Basidia few in the studied material, cylindrical or clavate, with 4 sterigmata, 8–15×4.5–5.6 µm.

Basidiospores ellipsoid to broad cylindrical, thin-walled, smooth, CB–, IKI–, (3.8–)4.2–5.5(–6.3) × (2.4–)2.7–3.5(–4.2) µm, L=4.72 µm, W=3.10 µm, Q²=(1.3–)1.4–1.8(–1.9), Q=1.52, n=122/4.

Table 1. Spore measurements of studied specimens of *Irpex* spp. and *Oxyporus* spp. Combined statistics for each species are printed in bold.

Specimen	Length (µm)	L	Width (µm)	W	Q'	Q	n
<i>Irpex cremicolor</i>	(3.6-)3.8-5.0(-5.9)	4.25	(2.3-)2.4-3.2	2.67	(1.3-)1.4-1.8(-2.0)	1.59	120/3
isotype	(3.6-)3.7-4.8(-5.3)	4.21	2.5-3.1(-3.2)	2.79	1.3-1.7(-1.9)	1.51	30
Kulju 1004	(3.7-)3.8-4.6(-4.9)	4.12	(2.3-)2.4-3.0(-3.1)	2.64	(1.3-)1.4-1.7(-1.8)	1.56	60
Lindgren 9849	3.9-5.6(-5.9)	4.58	2.3-3.1(-3.2)	2.61	1.6-2.0	1.76	30
<i>Irpex lacteus</i>	(4.5-)4.9-6.9(-8.1)	5.81	(2.0-)2.2-2.8(-2.9)	2.45	(1.9-)2.1-2.7(-2.8)	2.38	90/3
Haikonen 21980	(4.5-)4.6-6.5(-6.8)	5.60	(2.0-)2.1-2.5(-2.6)	2.29	(2.1-)2.2-2.7(-2.8)	2.44	30
Kotiranta 11786	(4.7-)4.8-7.9(-8.1)	5.71	2.2-2.8(-2.9)	2.38	(1.9-)2.0-2.8	2.40	30
Kotiranta 21291	(5.2-)5.4-6.9(-7.8)	6.14	2.5-2.8(-2.9)	2.67	(2.0-)2.1-2.7(-2.8)	2.30	30
<i>O. obducens</i>	(3.3-)3.5-4.7(-5.3)	4.07	(2.3-)2.5-3.3(-4.0)	2.98	(1.1-)1.2-1.5(-1.8)	1.37	160/4
Miettinen 2323	3.7-4.3	3.94	2.8-3.2	2.97	1.2-1.5	1.33	30
Niemelä 1699	3.3-4.2	3.65	2.3-3.0(-3.1)	2.67	(1.2-)1.3-1.5	1.37	30
Niemelä 1702	(3.7-)3.8-4.9(-5.3)	4.31	2.7-3.7(-4.0)	3.12	(1.1-)1.2-1.5(-1.7)	1.38	70
Niemelä 5729	(3.4-)3.5-4.5(-4.9)	4.04	2.7-3.2(-3.3)	2.98	(1.2-)1.3-1.5	1.36	30
<i>O. populinus</i>	(3.3-)3.4-4.7(-4.8)	4.14	(2.8-)3.0-4.2(-4.5)	3.65	1.1-1.3(-1.4)	1.14	90/3
Askola 1886	4.0-4.4(-4.5)	4.18	3.0-4.0(-4.1)	3.78	1.1-1.2(-1.3)	1.11	30
Miettinen 10522.1	(4.0-)4.1-4.8	4.41	3.4-4.4(-4.5)	3.91	1.1-1.2	1.13	30
Niemelä 4.VIII.1966	3.3-4.3	3.83	(2.8-)3.0-3.8(-3.9)	3.26	1.1-1.3(-1.4)	1.18	30
<i>O. schizoporooides</i>	(4.0-)4.1-5.0	4.49	2.6-3.2(-3.3)	2.94	1.4-1.6	1.53	30
<i>O. similis</i>	(3.8-)4.2-5.5(-6.3)	4.72	(2.4-)2.7-3.5(-4.2)	3.10	(1.3-)1.4-1.7(-1.9)	1.52	122/4
Weir X.1915	(4.0-)4.2-5.0(-5.2)	4.55	2.7-3.4	2.97	(1.3-)1.4-1.8	1.53	30
Weir IX.1915	(4.1-)4.3-5.2	4.80	(2.5-)2.6-3.4	3.14	1.4-1.7	1.53	30
Weir VIII.1917	(4.2-)4.3-5.0(-5.8)	4.72	(2.2-)2.7-3.4(-3.5)	3.06	1.4-1.8	1.54	30
Weir 12.X.1920	(3.8-)4.0-6.3	4.79	2.7-3.9(-4.2)	3.22	1.3-1.7(-1.9)	1.49	32

Distribution. The type material and other specimens studied here come from the Pacific Northwest of the United States.

Ecology. All the specimens studied have been collected from *Populus trichocarpa*.

Remarks. The lectotype has virtually no hymenium or spores left (a few collapsed and bloated were seen), but is otherwise in a tolerable condition. The other contemporary specimens attached to the same herbarium sheet have been collected from the same region by the same collector, J.R. Weir. They clearly represent the same species as the lectotype and have been utilised in composing

the present description and for spore measurements. As the type, they are not in the best condition either, lacking proper hymenium.

Oxyporus similis is characterised by a resupinate habit, heavily encrusted tramal cystidia and thin-walled, acyanophilous, ellipsoid spores. Several other species of *Oxyporus* share similar characters.

Vampola (1992) considered *O. similis* as a synonym of *O. obducens*, described from Germany. Donk (1967) placed *O. obducens* in synonymy with *Oxyporus populinus* (Schumach.) Donk. The current concepts clearly treat *Oxyporus populinus* and *O. obducens* as two distinct species: the pileate, perennial *O. populinus* with subglobose spores versus resupinate, annual, thin *O. obducens* with ellipsoid spores. Here we discuss *O. obducens* as regarded by European authors (e.g. Ryvarden & Gilbertson 1994).

Although *O. similis* and *O. obducens* are rather similar, we prefer to keep them apart for the moment. They share similarly shaped spores, hyphal structure and deep-rooting, heavily encrusted tramal cystidia. There are nevertheless minor differences. Spores in the specimens of *O. obducens* studied here were in average slightly shorter ($4.1 \times 3.0 \mu\text{m}$, Tab. 1) than those of *O. similis* ($4.7 \times 3.1 \mu\text{m}$). The spores of *O. obducens* are also slightly thick-walled and weakly cyanophilous, similar to those of *Hyphodontia sambuci* (Pers.) J. Erikss. but unlike *O. similis*. The hyphae of *O. obducens* are more or less homogenous throughout the basidiocarp and clearly thick-walled in trama, ($1.8\text{--}2.6\text{--}3.2\text{--}(4) \mu\text{m}$ in diameter. In *O. similis* the tramal hyphae are thin- to slightly thick-walled, and they contrast to the thick-walled and broader subicular hyphae.

We have not studied the North American material of *O. similis* extensively and can not state if it is homogenous or if *O. obducens* is also present in North America. Comprehensive research on these taxa, based on fresh material, would be needed to answer such questions, and also to confirm the status of *O. similis*.

Oxyporus corticola (Fr.) Ryvarden and *Oxyporus latemarginatus* (Durieu & Mont.) Donk are fairly similar to *O. similis* macroscopically. Microscopically, their larger, cyanophilous spores and cystidia, which are hymenial and not arising in the trama as in *O. similis*, separate them from *O. similis*.

Oxyporus pellicula was described from Java and has pellicular basidiocarps with irregular, often dentate shallow pores quite unlike those of *O. similis*. Other resupinate *Oxyporus* and *Rigidoporus* species differ in the nature of their cystidia, shape or size of the spores, or by having thick-walled and cyanophilous spores.

Discussion

The genus name *Irpex* has been in use for over 180 years, and has traditionally been kept as a morphologically defined genus including species with split tubes

or spinose hymenophore. To date, 200 species have been combined to *Irpex* (Index Fungorum 2007), but views differ on how to define the genus. Maas Geesteranus (1974), Ryvarden (1991) and Niemelä (2005) accept only one or a few species in the genus, whereas Kotiranta & Saarenoksa (2002) included the related *Junghuhnia* (polypores) and *Steccherinum* (hydroid fungi) in *Irpex*.

Comprehensive sequencing of numerous species currently placed in the genus is necessary to settle the taxonomic position and extent of the genus. In its wide sense *Irpex* is clearly unnatural as it has been used as a “dumping ground” for almost any hydroid or lacerate wood-inhabiting basidiomycete.

Irpex lacteus is the type species of *Irpex*. Since the new species reminds it more than any other polypore or hydnceous fungus, *Irpex* is the most suitable genus for placing the new species.

SPECIMENS STUDIED—*Irpex cremicolor*. **Finland**. Kainuu: Kuhmo, Pitkävaara, spruce-dominated old-growth forest, on fallen *Betula* with *Phellinus cinereus*, 1.X.1997 M. Lindgren 9849 (H). Kuusamo: Taivalkoski, Metsäkylä, Aitto-oja, rich, paludified semi-natural spruce forest, on *Betula* with *Phellinus igniarius*, 21.IX.2004 M. Kulju 1004 (H, O). **Norway** (see type).

Irpex lacteus. **Finland**. Etelä-Häme: Lahti, Ahtiala, on *Acer platanoides*, 28.X.2002 V. Haikonen 21980 (H); Luhanka, Lempää, on *Sorbus aucuparia*, 21.V.2006 H. Kotiranta 21291 (H). **Russia**. Sverdlovsk: Kirovgrad NW, Visim Nat. Res., on *Salix caprea*, 17.IX.1994 H. Kotiranta 11786 (H).

Oxyporus obducens. **Finland**. Varsinais-Suomi: Turku, Ruissalo Nat. Res., on *Quercus robur*, 29.IX.1993 T. Niemelä 5729 (H); 28.X.2000 O. Miettinen 2323 (H). **Germany**. Hessen: Schauenburg-Elmshagen, on *Fagus sylvatica*, 7.IX.1979 T. Niemelä 1699, 1702 (H); Nordrhein-Westfalen: Kerpener Broich Nat. Res., on *Populus*, 22.X.1967 H. Gorholt (H).

Oxyporus populinus. **China**. Jilin: Antu, Erdao Bai He, on *Acer?*, 26.VIII.2005 O. Miettinen 10522.1 (H). **Finland**. Varsinais-Suomi: Turku, Kupittaa, on *Populus*, 11.X.1887 O. Karsten (H); Uusimaa: Helsinki, Pikku-Huopalahti, 5.XI.1900, E. Häyrén (H); Kaivopuisto, on *Acer*, 4.VIII.1966 T. Niemelä (H). Nurmijärvi, on *Quercus*, 22.X.1985 P. Askola 1886 (H).

Oxyporus pellicula. **Indonesia**. Java. ‘*Polyporus pellicula*’, F.W. Junghuhn 17, (type, L0053199).

Oxyporus schizoporoides. **Russia**. St. Petersburg, Rzhevka (59°58' N, 30°30' E), 1.VI.2004 I. Zmitrovich (H).

Oxyporus similis. **USA**. Idaho: Bonner County, Priest River, IX.1915 J.R. Weir US242517; X.1917 J.R. Weir US242515; 12.X.1920 J.R. Weir US242514; see lectotype. Montana: Missoula, X.1915 J.R. Weir US0242518.—All specimens grew on *Populus trichocarpa* and are deposited in BPI.

Acknowledgments

We express our sincere gratitude to Gunnar Kristiansen, Matti Kulju and Mariko Lindgren, who collected the material and made it possible to prepare this study. We thank Nils Hallenberg (Gothenburg) and Joost Stalpers (Utrecht) for reviewing the

manuscript. Teuvo Ahti (Helsinki) kindly revised the Latin description. The Finnish Ministry of Environment research programme PUTTE and the EU programme SYNTHESYS provided financial support for this study.

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