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Polypore *Skeletocutis lenis* and its sib *S. vulgaris*

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Skeletocutis lenis (P. Karst.) Niemelä is a poroid basidiomycete, living on dead wood and causing a white rot. A study of herbarium material revealed that the common concept of the species includes another species, *S. vulgaris* (Fries) Niemelä & Y.C. Dai, *n. comb*. Both species are described and illustrated. *Skeletocutis lenis* is characterized by perennial basidiocarps, fairly big pores and cylindrical, strongly curved spores; its generative hyphae lack swollen tips at dissepiment edge and hymenium; its skeletal hyphae are mostly > 3 µm in diam, bear a distinct lumen, and swell in KOH. *Skeletocutis vulgaris* is as a rule annual, small-pored, and its spores are cylindrical, moderately curved, and narrower than those of *S. lenis*. Generative hyphae of the dissepiment edge and hymenium occasionally have a swollen tip. The skeletal hyphae of *S. vulgaris* are mostly < 3 µm in diam, subsolid without a distinct lumen, and do not change or only slightly swell in KOH. The former has a northerly distribution and prefers fallen trunks of *Pinus*, while *S. vulgaris* is more southern and inhabits a wide range of both gymnosperm and angiosperm hosts. These two species have different ecology: *S. lenis* usually lives on very rotten wood in moist places, while *S. vulgaris* inhabits recently decorticated trunks, frequently in dry localities. Both species are found in Europe, Asia and North America.

Key words: Basidiomycetes, polypores, *Skeletocutis lenis*, *S. vulgaris*, taxonomy

INTRODUCTION

Physisporus lenis P. Karst. is a poroid basidiomycete originally described from Finland (Rabenhorst 1886). It is a white-rot fungus, characterized by a dimitic hyphal structure, acyanophilous skeletal hyphae, long-necked cystidioles, stellate crystal agglomerations attached to generative hyphae, and cylindrical but strongly curved (lunate) spores. These features were the reason why the species was proposed to be included in the genus *Skeletocutis* Kotl. & Pouzar as *S. lenis* (P. Karst.) Niemelä (Renvall *et al.* 1991).

Donk (1967) studied a Friesian collection of *Polyporus vulgaris* Fr. in Uppsala (herbarium UPS). The authentic material is a mixed collection, including both what is commonly known as *Skeletocutis subincarnata* (Peck) Jean Keller, and two fragments of what Donk thought to be *S. lenis*. The description of *P. vulgaris* by Fries (1821: 381) indisputably points towards the former (‘*pervulgatus*’, ie. extremely common; on pine and also on

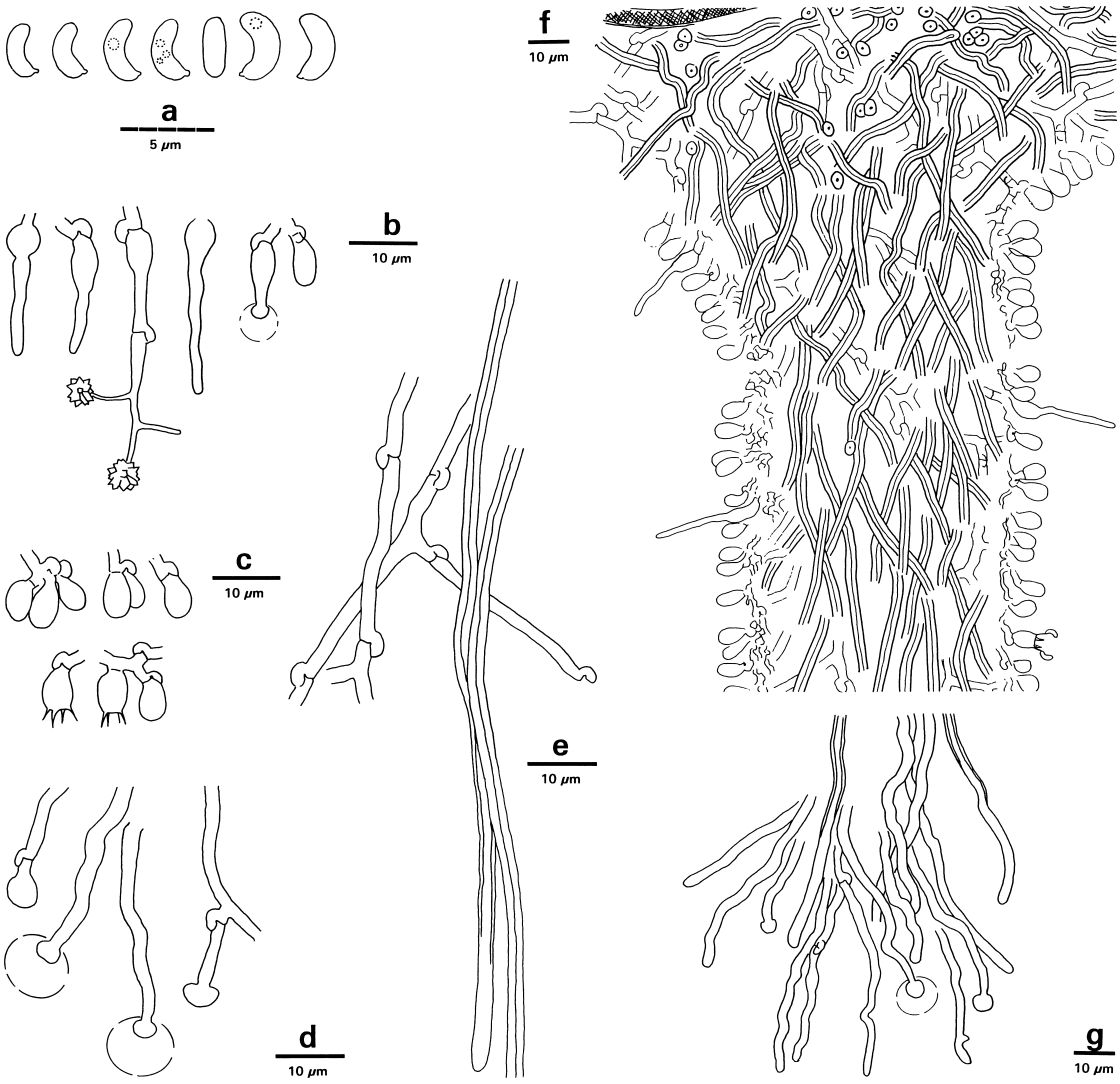

Fig. 1. Anatomical details of *Skeletocutis vulgaris* (Fr.) Niemelä & Y.C. Dai (drawn from *Niemelä 5981*). — a: Basidiospores. — b: Cystidioles and a 'halocystidium' from hymenium. — c: Basidia and basidioles. — d: Swollen tips (halocystidia) and mucous bulbs from dissepiment edge. — e: Generative and skeletal hyphae. — f: A section through subiculum and tube. — g: Hyphae at the dissepiment edge.

leaves, ie. on adjacent debris). However, Donk very unfortunately selected the latter as the lectotype, although he did dissent from abandoning the well-established but more recent name *lenis* in favour of *vulgaris*. Nobody else has proposed that substitution either.

While studying Polish specimens of *Skeletocutis lenis*, one collection turned out to deviate from the others in having significantly smaller spores and pores. In a similar way, two kinds of specimens were found in Chinese material from the Changbai Mountains. After these observations, we made a wider study from Europe, Northeast and Central Asia, and North America. Now we confirm that there are two species in the *Skeletocutis lenis* complex.

The two species lack the sharp-pointed encrustations on hyphae which characterize most species of the genus, but other hyphal structures and the type of rot agree with the characteristics of *Skeletocutis*. The inclusion of *S. lenis* in the genus was prompted by a comparison by David

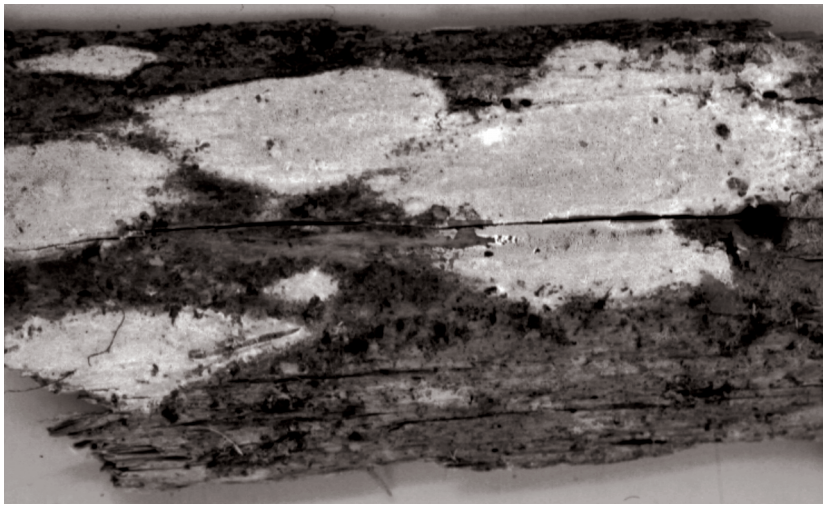

Fig. 2. *Skeletocutis vulgaris* (Fr.) Niemelä & Y.C. Dai. Herbarium specimen *Niemelä 5845*. Photograph T.N., × 1.2.

(1982), and it was discussed by Renvall *et al*. (1991).

The specimens examined for the present study will be cited in the following text. The microscopical routine used in the study is the same as presented by Dai (1995).

DESCRIPTIONS

Skeletocutis vulgaris (Fr.) Niemelä & Y.C. Dai, *n. comb*. (Figs. 1 and 2)

Polyporus vulgaris Fr., Systema mycologicum, 1: 381. 1821. — Lectotype: "*Polyporus vulgaris*", Femsjö (UPS, number "2" on a specimen sheet; selected by Donk 1967; selection defined more accurately here). Another representative specimen: "*Poria lenis*", Sweden. Småland, Femsjö, *Sorbus aucuparia*, 26.IX.1948 *Lundell 5681 & Haglund*, Fungi Exsicc. Suecici no. 1824 (UPS).

Poria calcea var. *coriacea* Bourd. & Galzin, Hyménomycètes de France: 674. 1927. Original material: France. Aveyron, *Castanea*, XII.1914 *Galzin 16928*; *Pinus*, 3.XI.1911 *Galzin 10158*; *Populus*, 12.XII.1907 *Galzin 2346*; *Populus*, 12.V.1914 *Galzin 15283* (all in PC). Sweden. Småland, Femsjö, ? angiosperm, 26.VII.1929 *Nannfeldt 2702* (herb. Bourdot 43273, PC).

Poria calcea f. *micropora* Bourd. & Galzin, Hyménomycètes de France: 674. 1927. Original material: France. Aveyron, *Juniperus communis*, 5.IX.1912 *Galzin 11789*; *Pinus nigra,* VIII.1910 *Galzin 6859*; *Pinus*, 17.IV.1908 *Galzin 3118*; *Prunus*, 12.XII.1907 *Galzin 2346* (all in PC). Haute-Marne, *Picea*, X.1919 *Maire 1268*; *Pinus,* X.1919 *Maire 1296* (all in PC).

Basidiocarps mostly annual, resupinate, soft, when dry corky, making up ellipsoid patches, 4–10 × 1–3 cm, sometimes larger, 1–2(–5) mm thick, usually very thin. Margin thinning out, fimbriate, usually pores extend to the very edge. Pore surface white or creamy white, when dry yellowish cream; pores round, fairly regular, (5–)6–8(–9) per mm (n = 205/12). Section: white throughout, subiculum extremely thin; tubes usually with no layers, consistency corky (somewhat flexible) when bent.

Hyphal system dimitic in all parts, generative hyphae smooth (not encrusted), septa with clamp connections, skeletal hyphae IKI–, CB–, KOH–.

Subiculum. Hyphal structure homogeneous, interwoven. Skeletal and generative hyphae equally common, skeletals (1.9–)2–2.9(–3.1) µm in diam (n = 87/5). Stellate crystal clusters very rare.

Tubes. Hyphae subparallel or loosely interwoven. Generative hyphae thin-walled, (1.3–)1.5–2.2(–2.3) µm in diam (n = 36/2). Skeletal hyphae thick-walled to subsolid (lumen capillary), hyaline, winding, (2–)2.1–2.9(–3.2) µm in diam (n = 173/9). Dissepiment edge with both generative and skeletal hyphae (generative hyphae commoner), which are slightly winding, of even thickness, with a few crystal clusters but otherwise smooth. Some generative hyphae bear a swollen tip in dissepiment and hymenium; such a tip may be covered by a mucous droplet. Subhymenium indistinct.

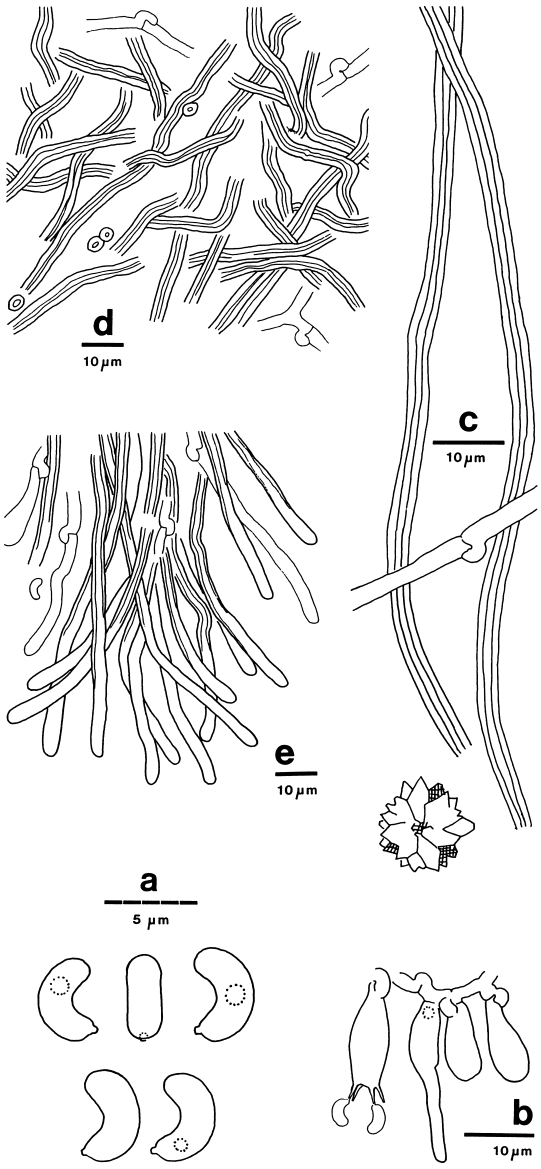

Fig. 3. Anatomical details of *Skeletocutis lenis* (P. Karst.) Niemelä (drawn from *Penttilä 444*). — a: Basidiospores. — b: Basidium, basidioles and a cystidiole. — c: Generative hypha, skeletal hyphae and a stellate crystal agglomeration. — d: A section through subiculum. — e: Hyphae at the dissepiment edge.

Basidia barrel-shaped, (6–)6.5–8.5(–10) × (3.6–)3.8–4.7(–5) µm (*n* = 66/7), basidioles in shape similar to basidia, slightly smaller; cystidioles frequent, basally swollen, with sharp or often hyphoid neck which may be branched, apex sometimes bearing a few crystals. No hyphal pegs.

Spores. Basidiospores narrowly cylindrical, slightly thicker in the middle, moderately curved, with blunt ends, guttules indistinct or none, thin-walled, hyaline, IKI–, CB–, (2.6–)2.9–3.6(–4) × (0.8–)0.9–1.4(–1.7) µm, L = 3.14 µm, W = 1.08 µm, Q = 2.44–3.11 (*n* = 415/14).

Distribution and host. We have studied *Skeletocutis vulgaris* in the field in Estonia, Poland and North China. We found European herbarium material of the species from Sweden, Poland, Slovakia, France, and Croatia; in Asia it was also found in South China and Kazakhstan. In North America its range covers Quebec of Canada, and New York and North Carolina of the U.S.A.

In Europe, *Skeletocutis vulgaris* mostly grows on *Picea*, occasionally on *Pinus* or *Juniperus* and frequently on angiosperms, e.g. *Fagus, Quercus, Sorbus*. In North America, according to the specimens we have studied, it grows on gymnosperms. In China and Kazakhstan, it inhabits several genera of both gymnosperms and angiosperms.

Specimens studied. — **Canada**. Quebec, Gatineau Nat. Park, on *Abies*, 14.X.1967 *Eriksson 9067* (GB), *9079* (GB); *Pinus*, 5.VIII.1967 *Eriksson 7094* (GB), 10.VIII.1967 *Eriksson 7210* (GB). **China**. Jilin Prov., Changbaishan Forest Res., *Abies*, 29.VII.1993 *Dai 827* (H); *Pinus*, 13.IX.1995 *Dai 2076c* (H). Neimenggu (Inner Mongolia) Auto. Reg., IX.1917 *Licent 759* (PRM 501104). Jiangxi Prov., Sanqingshan, gymnosperm, 14.VII.1994 *Hattori* (TFM). **Croatia**. Plitvicka Jezera Nat. Park, *Abies*, 10.X.1977 *Tortić 270-77* (H). **Estonia**. Harju, Haiba, *Picea*, 13.V.1995 *Niemelä 5845 & Dai* (H). **France**. Bordeaux, Mimizan, *Pinus*, 5.XI.1986 *Hallenberg 9670* (GB). **Iran**. Gilan, Asalem, angiosperm, 16.VII.1976 *Hallenberg 1910* (GB 23899); Mazanderan, Jangale dormod, angiosperm, 14.VII.1976 *Hallenberg 1898* (GB 23898). **Kazakhstan**. Kaitag Distr., *Carpinus*, 13.IX.1973 *Parmasto* (TAA 58049); Magaramkent Distr., *Juglans*, 17.IX.1973 *Parmasto* (TAA 58112). **Poland**. Hajnówka Distr., Białowieża Nat. Park, *Picea*, 27.VIII.1973 *Holubova* (PRM 870122, H). Kielce Distr., Swiętokrzyski Nat. Park, *Picea*, 3.X.1978 *Niemelä 1401* (H). **Sweden**. Halland, Mästocka, *Picea*, 14.VI.1964 *Strid* (GB 9335); Tjolöholm, *Quercus*, 2.IX.1965 *Strid* (GB 9694); Tostared, *Fagus*, 19.III.1972 *Jeppson 219* (GB). Småland, Femsjö, *Fagus*, 6.VIII.1937 *Lundell* (UPS 1538); *Pinus*, 20.VIII.1929 *Nannfeldt 3245* (UPS); *Pyrus*, 9.X.1911 *Romell 12990* (UPS); *Quercus*, 18.VII.1929 *Nannfeldt 2505* (UPS); *Sorbus*, 26.IX.1948, *Lundell 5681 & Haglund* (UPS); gymnosperm, 25.VII.1929 *Nannfeldt 2693* (UPS). Västergötland, Sandhult, *Pinus*, 10.IX.1969 *Hjortstam 2119* (GB 18294). Stockholm, Lidingö, gymnosperm, 12.V.1913 *Romell 14269* (H). **USA**. New York, Adirondack, gymnosperm, 20.X.1935 *Lowe 1624* (H); Warrensburg, *Tsuga*, 20.VIII.1942 *Lowe 2217* (GB). North Carolina, Black Mountain, 16.V.1927 *Boyten* (herb. Bourdot 42386, PC).

Fig. 4. *Skeletocutis lenis* (P. Karst.) Niemelä. A fresh basidiocarp. Specimen *Niemelä 2072*. Photograph T.N. *in situ*, × 0.5.

Skeletocutis lenis (P. Karst.) Niemelä (Figs. 3 and 4)

Physisporus lenis P. Karst., in Rabenhorst, Fungi Exsicc. Eur. Extraeur. 16: 3527. 1886 (H, holotype, studied).

Poria lunuliospora Pilát, Bull. Soc. Mycol. France 51: 381. 1936 (PRM 34274, holotype, studied).

Basidiocarps perennial, resupinate, soft, when dry soft corky, making up ellipsoid patches, 5–20 × 2–5 cm, sometimes much larger, up to 10 mm thick. Sterile margin pellicular or fimbriate, thinning out, usually absent (pores extend to the thin edge); in old specimens margin abrupt. Pore surface creamy white, when old and dry cream, more or less shining; pores round, (3–)4–6(–7) per mm (n = 200/12), usually with scattered bigger pores. Section: white throughout, subiculum very thin, annual layers in tubes indistinct; dry specimens split easily along tubes if bent.

Hyphal system dimitic in all parts, generative hyphae not encrusted, septa with clamp connections, skeletal hyphae IKI–, CB–, swelling distinctly in KOH.

Subiculum. Hyphal structure homogeneous, interwoven. Skeletal hyphae dominating the structure, (2.6–)2.8–3.4(–3.6) µm in diam (n = 60/2). Stellate crystal clusters common.

Tubes. Hyphae fairly parallel. Generative hyphae thin-walled, (1.6–)1.8–3(–3.2) µm in diam (n = 30/1). Skeletal hyphae thick-walled with a distinct lumen, hyaline, straight, (2.7–)2.8–3.6 (–3.9) µm in diam (n = 188/7). Dissepiment edge with both generative and skeletal hyphae (skeletals commoner), which are fairly straight, of even thickness, occasionally with crystal clusters but otherwise smooth. Subhymenium indistinct. Basidia short clavate, 10–13.5(–15) × (4.2–)4.5–5.5 (–6) µm (n = 78/5), basidioles in shape similar to basidia, slightly shorter; cystidioles basally swollen, with sharp or often hyphoid neck, apex sometimes bearing a few crystals. No hyphal pegs.

Spores. Basidiospores thick cylindrical, strongly curved ('lunate'), with blunt ends, biguttulate, thin-walled, hyaline, IKI–, CB–, (3.5–)3.9–4.9(–5) × (1.2–)1.5–2(–2.1) µm, L = 4.35 µm, W = 1.76 µm, Q = 2.29–2.74 (n = 360/12).

Distribution and host. *Skeletocutis lenis* is a more or less northerly, boreal species. According to the specimens we have examined, it occurs in Sweden, Finland, Russia (Russian Karelia, Karachayevo–Cherkess Reg., the Altai Mts., Siberia and the Far East), Kyrgyzstan (Tianshan Mts.), Northeast China, and British Columbia of Canada.

Skeletocutis lenis mostly grows on gymnosperms (one collection on *Fagus* and one on *Salix* from Sweden). In North Europe it usually lives on *Pinus*, very seldom on *Picea*. A characteristic

host is a long-ago fallen, moss-covered *kelo* tree (for a definition of this term, see Niemelä *et al.* 1995) in virgin forest. The species occurs on *Thuja* and *Pseudotsuga* in Canada, and on several genera (*Abies, Picea, Pinus*) of gymnosperms in Siberia and the Far East of Russia, Northeast China and the Tianshan Mts. of Kyrgyzstan.

Specimens studied. — **Canada**. British Columbia, Vancouver Island, on *Pseudotsuga*, 7.IX.1967 *Eriksson 7594* (GB); *Thuja*, 12.IX.1967 *Eriksson 7955* (GB); gymnosperm, 1.IX.1982 *Hallenberg 6942* (GB). Wells Grey Prov. Park, *Thuja*, 3.VIII.1969 *Eriksson 13272* (GB). **China**. Jilin Prov., Changbaishan Forest Res., *Abies,* 14.IX.1995 *Dai 2090* (H), *Pinus*, 12.IX.1995 *Dai 2046* (H). Huinan County, *Pinus*, 18.X.1993 *Dai 1702* (H). **Finland**. Satakunta, Ikaalinen, *Pinus*, 15.VI.1986 *Penttilä 110* (H), 5.X.1986 *Penttilä 444* (H). Etelä-Häme, Kuru, *Pinus*, 21.IX.1986 *Penttilä 308* (H); Lammi, *Picea,* 13.IX.1983 *Niemelä 2945* (H). Perä-Pohjanmaa, Tervola, *Pinus*, 29.VII.1979 *Niemelä 1532 & Kotiranta* (H). Koillismaa, Kuusamo, *Pinus*, 2.VIII.1979 *Niemelä 1587 & Kotiranta* (H). Kittilän Lappi, Kittilä, *Pinus*, 29.VIII.1970 *Niemelä* (H). **Kyrgyzstan**. Tianshan Interior, *Picea*, 5.VI.1971 *Kullman* (TAA 65141). **Russia**. Gorno–Altayskiy Auto. Reg., Altai Nat Res., *Abies*, 24.VIII.1959 *Parmasto* (TAA 7940). Karachayevo–Cherkess Region, Teberda Nat. Res., *Picea*, 21.IX.1968 *Parmasto* (TAA 53188). Khabarovsk Terr., Bolshe-Khekhtsirski Nat. Res., *Abies*, 2.VIII.1982 *Parmasto* (TAA 104582). Primorye Terr., Kavalerovo, *Pinus*, 3.X.1977 *Parmasto* (TAA 101811). Russian Karelia, Kostamus, *Pinus,* 1.IX.1995 *Lindgren 3352* (H). Sakhalin, Nevelsk Distr., *Abies*, 15.IX.1979 *Jäva* (TAA 93196). **Sweden**. Småland, Femsjö, *Fagus*, 4.X.1939 *Lundell* (UPS 1668). Stockholm, Lidingö, gymnosperm, 12.V.1913 *Romell* (UPS 14269). Dalarne, Idre, *Salix*, 31.VIII.1980 *Laia & Hallenberg* (GB). Ångermanland, Junsele, *Pinus*, 20.IX.1970 *Hjortstam* (GB 18291). Pite Lappmark, Arvidsjaur, *Pinus*, 8.VII.1966 *Eriksson* (GB 9691).

COMPARISON

The common microscopical characters of *Skeletocutis lenis* and *S. vulgaris* are a dimitic hyphal structure, generative hyphae bearing clamp connections, skeletals being negative in IKI and CB, the lack of cystidia, the presence of cystidioles with swollen base; stellate crystal clusters being present on hyphae or cystidioles, and the cylindrical, curved shape of the spores. The stellate crystal agglomerations are the most characteristic common feature for the two species.

In the previous studies, Romell (1926), Baxter (1936) and Eriksson (1949) mentioned variability in the *Skeletocutis lenis* complex. Romell (1926) tried to separate the small-spored type from the other species, but could not find stable and clear characters on which to base the division.

The important differences between *Skeletocutis lenis* and *S. vulgaris* are summarized in Table 1. In addition to the listed characters, *S. lenis* is a typically perennial species. Its pores are white to cream upon drying, and some pores are much bigger than the basic size. Its tubes easily split if a dry fruit body is bent. Generative hyphae bear no swollen tips (halocystidia) in dissepiment and hymenium. Skeletal hyphae are more or less straight, thick-walled, but bear a distinct lumen, and become swollen in KOH; they are somewhat thicker in *S. lenis* than in *S. vulgaris*. The reaction in KOH is distinct in particular in the Finnish material of *S. lenis*. Basidia are short clavate, and exceed 10 µm in length. Spores of *S. lenis* are strongly curved to lunate and have a uniform diameter.

Table 1. A comparison of *Skeletocutis lenis* (P. Karst.) Niemelä and *S. vulgaris* (Fr.) Niemelä & Y.C. Dai, based on specimens from Europe, Asia and North America.

	S. lenis	*S. vulgaris*
Pores	4–6 per mm (*n* = 200/12)	6–8 per mm (*n* = 205/12)
Spores	3.9–4.9 × 1.5–2 µm L = 4.35 µm, W = 1.76 µm Q = 2.29–2.74 (*n* = 360/12)	2.9–3.6 × 0.9–1.4 µm L = 3.14 µm, W = 1.08 µm Q = 2.44–3.11 (*n* = 415/14)
Length of basidia	10–13.5 µm (*n* = 78/5)	6.5–8.5 µm (*n* = 66/7)
Skeletals in CB	2.8–3.6 µm in diam (*n* = 188/7)	2.1–2.9 µm in diam (*n* = 173/9)
Skeletals in KOH	3.5–4.8 µm in diam (*n* = 195/7)	2.7–3.5 µm in diam (*n* = 131/7)

Stellate crystals are abundant all the way from subiculum down to the dissepiment edges.

Skeletocutis vulgaris can be perennial, too, but it is usually annual. Its pores are white when fresh, but become yellowish upon drying, and the pore surface is even. Tube consistency is corky when bent and hence the specimen does not split so easily. Some generative hyphae bear a swollen tip (they are very similar to the halocystidia in some corticioid species), these organs are common in particular in juvenile basidiocarps. This was mentioned by Eriksson (1949), and his drawing of '*Poria lenis'* in that paper depicts *Skeletocutis vulgaris*. A slimy or mucous bulb or droplet sometimes is dissociated around the swollen tip; it is quite translucent, and observed in phase contrast illumination only. Eriksson (1949) says that it stains red in Sudan III reagent. Skeletal hyphae of *S. vulgaris* are flexuous, in mature fruit bodies subsolid without a distinct lumen, and they mostly remain unchanged or only slightly swell in KOH. Basidia are barrel-shaped, and do not exceed 10 µm in length. Spores are cylindric, mostly broadest in the middle and slightly thinning towards both ends. Stellate crystals are not very common.

The distribution of *S. lenis* is more northern than that of *S. vulgaris*. Furthermore, the two species have different ecology. *Skeletocutis lenis* usually lives on very rotten wood in moist places, for instance, shady old-growth forests, and it is a decayer of the final stage of wood decomposition. *S. vulgaris* inhabits both recently decorticated, still hard trunks and more rotten wood, and it frequently occurs in dry localities.

SOME RELATED TAXA

Poria krawtzewii Pilát was treated as a synonym of *Poria lenis* by Pilát (1936–1942). However, it has ellipsoid spores (Kotlaba & Pouzar 1991), and so is different from the *S. lenis* complex.

Poria earlei Murrill, *P. montana* Murrill and *P. tenuipora* Murrill were described from Jamaica (Murrill 1920ab). Lowe (1966) considered them to be synonymous with *Poria lenis*. The type specimens of the above three names were studied. Evidently *P. montana* and *P. earlei* represent a single species. The specimens are perennial, have small pores (7–9 per mm), a few stellate crystals, and their skeletals bear a distinct lumen (2–3 µm in diam). *Poria tenuipora* is annual, has small pores (8–9 per mm) as well, abundant stellate crystals, and its skeletals are subsolid (3–4 µm in diam). It is evident that *P. tenuipora* is different from *P. earlei* and *P. montana*. The hyphal structures of the above species are very similar to those of the *S. lenis* complex, but the materials are not good enough to tell whether they represent *S. lenis*, *S. vulgaris* or something else. Because all these specimens are sterile, we are reluctant to identify them. The names are more recent than *vulgaris* and *lenis*, and so they are less important in the nomenclature.

Specimens studied. — *Poria earlei*: **Jamaica**. Rose Hill, 30.X.1902 *Earle 297* (type, NY, BPI 239038). — *Poria montana*: **Jamaica**. New Haven Gap, on gymnosperm, 4.I.1909 *Edna & Murrill 765* (type, NY, BPI 240985). — *Poria tenuipora*: **Jamaica**. Cockpit, on decayed wood, 12–14.I.1909 *Murrill & Harris 855* (type, NY, BPI 243617).

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