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The *Lactarius torminosus*-group in Greenland

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Introduction

During a survey of *Lactarius* in Greenland (Knudsen & Borgen 1982), we had difficulties in identifying some of the collections in the *Lactarius torminosus* group. The considered taxa involved *L. torminosus* (Schäff.: Fr.) S.F. Gray var. *torminosus*, *L. torminosus* var. *gracillimus* Lange and *L. pubescens* (Schrad.) Fr. *Lactarius scoticus* Berk. & Br. was added to the group after the redescription by Jahn (1982) as *L. favrei*. Even then most of our arctic records could not be referred to any known taxon or at best to a small form of *L. torminosus*. Having known this small taxon now for a number of years we are glad to use this occasion to describe it as a new species. The spores were studied and measured in Melzer's solution; their size is given without the ornamentation. All material studied is deposited in Copenhagen (C).

Key to the *Lactarius torminosus* group in Greenland

1. Stem of fully developed specimens remarkably short and massive, often less than 1/2 the cap diam.; fruitbody robust, predominantly whitish mixed with pale salmon or ochraceous; without concentric zones on the cap but when old often with coarse, irregular fissures; margin inrolled even when mature; gills emarginate to slightly decurrent. Spores 6.5–8.5×5.5–6.5 µm, ellipsoid, ornamentation a low reticulum, up to 0.4 µm. On dry, rich, often calcareous or clayey soil associated with *Betula pubescens*, *B. nana* and *B. glandulosa* 1. *L. pubescens*
- 1*. Stem of fully developed specimens as long as or longer than cap diam.; fruitbody salmon or ochraceous, if whitish then more slender and margin soon expanded; growing in bogs 2
2. Fruitbody whitish to ochraceous; cap not or only indistinctly zonate, sometimes finely umbonate. Spores 6.5–8.5×5–6.5 µm. Associated with *Betula pubescens* and *B. verrucosa* in raised bogs or on turf in moist habitats. *Not recorded from Greenland.* 2. *L. scoticus*

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- 2*. Fruitbody ochraceous to salmon; cap more or less concentrically zonate; stem soon hollow. Spores 7.5–8.5(–10)×5.5–7 μm 3
3. Cap when mature 4–10(–15) cm in diam.; stem 4–8×1–2 cm; fruitbody flesh-coloured to salmon. Associated with *Betula*. 3. *L. torminosus*
- 3*. Cap when mature 2–4(–6) cm in diam.; stem 1–2.5 (–3.5)×0.5–1 cm; ochraceous to flesh-coloured or pale salmon. Associated with *Betula nana* and *B. glandulosa* 4. *L. subtorminosus*

Description of taxa

1. *Lactarius pubescens* (Schrad.) Fr.

Syn.: *L. albus* Blum, *L. blumii* M. Bon, *L. groenlandicus* Terkelsen; *L. torminosus* ssp. *pubescens* (Schrad.) Konr. & Favre; *L. torminosus* var. *pubescens* (Schrad.) Lundell & Nannf. Misapplications: Neuhoff 1956 (incl. *L. scoticus*); Knudsen & Borgen 1982 (as *L. torminosus*).

Jahn (1982) discussed the taxonomy and nomenclature of this species. He showed that many previous descriptions of *L. pubescens* were of *L. scoticus* or a mixture of both. Good descriptions and pictures are given by Phillips (1981: p. 78), Korhonen (1984: p. 70, 72, 73), Hesler & Smith (1979: pl. 105, 106) and Jahn (1982: p. 77). Neuhoff (1956) mixed *L. pubescens* and *L. scoticus* on his plate II, no. 5. The two specimens to the left are *L. pubescens*, probably also the upper right specimen. The separating characters for *L. pubescens* are the overall whitish colour, the unzoned cap often becoming deeply cracked with age, the short stem giving it a stout and squat appearance. In addition, the firm flesh, conspicuously inrolled, thick margin, the crowded, emarginate gills, and the rather small spores distinguish it from *L. torminosus* and *L. subtorminosus*. *Lactarius pubescens* occurs predominantly on rich and dry soil.

In Greenland its distribution (Fig. 3) follows *Betula (nana)* as far north as this *Betula* grows (71°30' N). However, in Greenland it is not present in many well investigated places where *Betula* is found. It is very common both in the Søndre Strømfjord area on the west coast and on Jamesonland on the central east coast. These areas are rich in calcareous and clayey soils and the recorded distribution in Greenland points towards a preference for this type of soil.

Lactarius pubescens is widely distributed in temperate Europe (Neuhoff 1956) and North America (Smith 1979). It is also present in arctic-alpine areas in the Alaskan arctic (68° N) (Laursen & Ammirati 1982) and found in the mountain tundra of the Urals (66° N) by Knudsen (see material) and by Korhonen (1984) from northern Finland (68° N).

Material examined: GREENLAND: D. Boertmann 83.72; 89.37; T. Borgen 85.131; 86.162; B. Fredskild 24.08.1980; H. Knudsen 87.231; 91.64; H. Knudsen, T. Borgen & J. H. Petersen 83.3; H. Knudsen, S. A. Elborne & J. H. Petersen 89.45; idem 89.97; idem 89.209; idem 89.538; L. Lange 67.5–76; M. Lange 46.116; P. M. Petersen 72.44; 73.31; 73.122. – RUSSIA: Siberia, Tjumenskaja obl., N-Urals, Krasnij Khanmei, c. 40 km NW of Labytnangi, 66° 33' N, 65° 00' E, H. Knudsen (HK 90.331b).

2. *Lactarius scoticus* Berk. & Br.

Syn.: *L. torminosus* var. *gracillimus* Lange 1940, Fl. Agar. Danica vol. V, "Taxonomic conspectus" p. V and pl. 169 E; *L. favrei* Jahn 1982, Int. J. Myc. Lich. 1: 98.

Misapplications: Konrad & Favre 1935 (as *L. torminosus* ssp. *pubescens* (Schrad.) Konr. & Favre); Konrad & Maublanc 1937 (as *L. torminosus* ssp. *pubescens*); Lundell & Nannfeldt, Fungi Exsiccati Suecici no. 2335 (as *L. torminosus* var. *pubescens*); Ryman & Holmåsén 1984 (as *L. pubescens*).

Konrad & Favre (1935) and Konrad & Maublanc (1937) regarded *L. scoticus* as a synonym of *L. torminosus* ssp. *pubescens*. Similarly, J. E. Lange (1940) noted, when describing his *L. torminosus* var. *gracillimus*, that it hardly differed from *L. scoticus*. However, it was not until Jahn (1982) treated the problem in detail and gave an extended description of *L. scoticus* (as *L. favrei*) and compared it to *L. pubescens*. He pointed out that these two species are clearly separated. It has frequently been confused with *L. pubescens*, and mixed with this species both in descriptions and in pictures. Good pictures are given by Cooke (1888: pl. 1004 b, 938 b), Korhonen (1984: p. 71, 72), Ryman & Holmåsén (1984), Konrad & Maublanc (1937) and Moser & Jülich (1985, IV *Lactarius*, 7). On plate II no. 5 in Neuhoﬀ (1956), the three upper central specimens are most likely *L. scoticus*. The distinctive features reminiscent of *L. pubescens* are the slender habit, the ecology in mineral-poor bogs often with *Sphagnum*, the slightly inrolled, thin margin, the normally spaced, decurrent gills and the association with *Betula* spp.

This species is not recorded from Greenland, but since it has been reported from subarctic areas in Finland (Korhonen 1984) it is included here for comparison.

The American species *L. subpaludosus* Hesler & Smith is close to or identical with *L. scoticus*. In the description it differs mainly in the white latex becoming yellow on a piece of paper. This character is usually important in *Lactarius* taxonomy, but Hesler & Smith (1979) showed the existence of pairs of similar taxa in North America, only differing in the staining or unstaining latex (e. g. *L. torminosus* vs. *L. nordmanensis*, *L. pubescens* vs. *L. betulae*). In northern Europe, *L. mitissimus* vs. *L. lapponicus* constitute another such pair.

Material examined: DENMARK: Bornholm, Vang, 12. 8. 1977, T. Borgen; Fyn, Snarup Mose near Kværndrup, 29. 9. 1991, J. Vesterholt, (C, no. 11085); Jylland, Moesgård Skov s. of Århus, 6. 10. 1991, J. Vesterholt (C, no. 11109); Jylland, Fladbro near Randers, 2. 10. 1987, J. Vesterholt (C, no. 11504); Jylland, Silkeborg Vesterskov, 30. 9. 1987, J. Vesterholt (C, no. 15402). – SWEDEN: Fungi Exsiccati Suecici no 2335.

3. *Lactarius torminosus* (Schaeff. : Fr.) S. F. Gray

This is the well known species of the group. It is well depicted and described in many floras and monographs and need not be clarified. *Lactarius torminosus* is common in the northern temperate and boreal zones where *Betula* is present. In Greenland, only two collections are known, both from the southernmost part from scrubs of *Betula pubescens*. Whether the host or the climate is the limiting factor is not known. It is found much further north in the Scandinavian countries, but due to confusion with *L. subtorminosus* the exact limit is unknown. It is recognized from *L. subtorminosus* by the larger cap, longer and thicker stem, broader gills as well as the much stronger marginal tomentum.

Material examined: GREENLAND: Narssarssuaq, 17. 8. 1994, T. Læssøe (photo); H. Knudsen 91.20.

4. *Lactarius subtorminosus* Knudsen & Borgen, sp. nov. Figs. 1, 2, 3

Misapplications: M. P. Christiansen 1941, The Botany of Iceland III(II) 11: 218 (as *L. torminosus*, mat. in C); M. Lange 1946, Friesia III(3): 168; M. Lange 1957, Medd. Grønland 148(2): 49 (both as *L. torminosus* var. *gracillimus*); Kallio & Kankainen 1964, Ann. Univ. Turku A, II(32): 229 (as *L. torminosus* forma); Gulden & Lange 1971, Norw. J. Bot. 18(1): 33 (as 'a small form' of *L. torminosus*); Kobayasi et al. 1971, Bull. Nat. Sci. Mus. Tokyo 14(1): 78 (as *L. torminosus* var. *gracillimus*); Knudsen & Borgen 1982 (as *L. pubescens*); probably also Korhonen 1984 (as *L. torminosus* p. p., colour photo of "Abisko 5476").

Lactarius subtorminosus Knudsen & Borgen, sp. nov.

Lactario torminoso satis similis. Pileus 2–4, raro ad 6 cm diam., margine initio involuto, crasse tomentosus, deinde expansus, glabrior, planus, post depressus, opacus, ochraceus vel pallide roseo-salmoneus, plus minusve manifesto concentricè zonatus. Lamellae decurrentes. Stipes 1–2.5(–3) cm × 0.5–1 cm magnus, albidus vel colore pilei affectus. Lac parcum, aqueo-albidum. Sapor acer. Sporae 7.5–8.5(–9) × 5.5–6.5 µm magnae, ellipsoides vel late ellipsoides, crasse reticulatae. Cum *Betula nana* et *B. glandulosa* mycorrhizam formans. Typus die 20 Augusti anni 1992 prope urbem norvegicam Tromsø in valle Signaldalen a H. Knudsen & M. Sasa lectus, siccus in Museo Botanico Hauniensi (C) depositus.

Resembling a small *Lactarius torminosus*. – Cap when fully expanded 2–4 cm, rarely larger, one specimen seen measuring 6 cm, at first with inrolled margin densely covered with whitish, woolly tomentum, plane or slightly convex, soon becoming shallowly depressed at centre or when old even deeply de-



Fig. 1. *L. subterminosus*. The specimens are unfortunately very washed out from prolonged rain, causing the margin to be striate, which is unusual. – Bar = 1 cm. Photo J. H. Petersen (HK, TB & JHP 83.405).

pressed in some specimens, surface mat, rough-scaly, finely tomentose, ochraceous (e. g. Meth 6B4), pale salmon to salmon, soon with more or less distinct, concentric zones, darkest in centre, paler towards the margin, smooth or becoming so when old, slightly hygrophanous; margin when old fully expanded, becoming appressed tomentose. – Gills adnate becoming decurrent, slightly ventricose, 1–3.5 mm broad, whitish, normally spaced, c. 10/cm margin reaching the stem; gill-edge in young specimens finely white floccose. – Stem 1–2.5(3)×0.5–1 cm, obclavate, smooth, soon ± hollow, whitish or tinged with cap colour, at apex often with a narrow salmon belt, often slightly bent at the base. – Flesh fragile, whitish or pale salmon; milk sparse, watery-whitish. – Taste acrid. – Smell weak, sweetish-fruity.

Spore print whitish (thin layer). – Spores 7.5–8.5(–9)×5.5–6.5 μm, avg. 8.3×6.2 μm, with prominent apiculus, ellipsoid to broadly ellipsoid, Q(l/b) = 1.25–1.4, ornament a coarse reticulum, 0.4–0.8 μm high. – Basidia 30–35×10–12 μm, with 2–4 sterigmata, c. 5 μm long. – Cheilocystidia (macrocystidia) ventricose, with strongly attenuated apex, 35–40×6–8 μm. – Pleurocystidia (pseudo-



Fig. 2. Spores of *L. subtorminosus*, from the type ($\times 1500$). – Map of the distribution of the *L. torminosus* group in Greenland: Round dots: *L. subtorminosus*. – Triangles: *L. pubescens*. – Stars: *L. torminosus*. – Underlined symbols are from the same locality, indicated by the left dot. The S-point of Greenland is approximately 60° N, the N-point c. 83° N.

cystidia) cylindrical-sinuose with obtuse apex, free part c. $30 \times 4\text{--}5 \mu\text{m}$, with granular contents; macrocystidioid pleurocystidia similar to the cheilocystidia. – Pileipellis a badly developed ixocutis of repent, hyaline, septate hyphae, c. $5 \mu\text{m}$ broad, often gathered into sinuous fibrils.

Ecology. In Greenland *L. subtorminosus* is associated with dwarf *Betula* (*B. nana*, *B. glandulosa*). We believe it may also occur with non-dwarf taxa in subarctic-subalpine areas, but have so far not verified records yet. After recognizing *L. subtorminosus* as an independent species, we have noticed that *Betula* was always present nearby. Some of the first records of this species from Greenland were not accompanied by notes on the presence of *Betula*. We consider these as careless mistakes, and that *Betula* is the only mycorrhizal symbiont for *L. subtorminosus*. The preferred localities are moist areas along rivers and springs, but it was also found once in a *Sphagnum* bog. Fruiting occurs predominantly in August. The records from mainland Europe and Siberia are north of the polar circle. It has not been found in the Alps, where its hosts, the dwarf *Betula* are also missing.

Material examined: GREENLAND: D. Boertmann 86.15; T. Borgen 78.27; 80.54; 80.6–5; 80.109; 80.111; 82.38; 84.96; 87.9; 87.30; 87.132; 93.201; H. Knudsen 87.87; 87.2–49; 91.56; H. Knudsen, T. Borgen & J. H. Petersen 83.–81; 83.40–5; H. Knudsen, S. A. Elborne & J. H. Petersen 89.4–84; 89.5–43; H. Knudsen & T. Læssøe 84.2–19; L. Lange 67.2–84; M. Lange 46.2–24; 46.6–41; 67.91; 67.136; 71.47; P. M. Petersen 71.–54; 72.2–90; 72.3–58; 73.30; 73.2–31; 73.3–20; 77.–27; F. Terkelsen 64. – ICELAND: Skutústadir, 28.07.1935, M. P. Christiansen. – NORWAY: Tromsø fylke, Signaldalen, Paras, 20.08.1992, H. Knudsen & M. Sasa (typus; isotypus in O). – SWEDEN: Abisko, A. Michelsen (AM 92.12; 92.13; 92.19). – RUSSIA: Siberia, Tjumenskaja obl., S-Yamal Peninsula, along river Khadeta, c. 20 km. E of Biological Station, H. Knudsen (HK 90.284); Siberia, Tjumenskaja obl., N-Urals, Krasnij Khanmei, c. 40 km NW of Labytnangi, H. Knudsen, (HK 90.331a; 90.421).

This is a perfect diminutive of *L. torminosus*. We have known it for many years, and collected it in a number of arctic and subarctic areas. In Greenland it is the most common species from the group, and we suspect it is also common in other cold areas, since we have found it in most of the places where we looked for it, except the Alps. The distinguishing features from the similar *L. torminosus* are the small size and the mycorrhizal symbionts. Also the distribution is different for the two species. *Lactarius torminosus* is distributed in temperate, boreal, subarctic and subalpine areas and *L. subtorminosus* only in subarctic and arctic areas. The cheilocystidia are generally more attenuated than in *L. torminosus*.

Although the two species are remarkably similar they are also well distinguished. During the last ten years since we have been aware of this taxon, and

we have not seen collections which were difficult to assign to one of the two species.

We would like to point out that this new taxon could also be considered to be a subspecies of *L. torminosus*, but since a stable subspecific concept has not been developed/used within the higher fungi, we have for the time being given it specific rank. It is clearly a vicarious species for *L. torminosus* in cold areas with a smaller mycorrhizal symbiont. Pseudocystidia, i. e. apices of laticifers ending in the hymenium, are present in *L. subtorminosus*. In contrast, Hesler & Smith (1979) and Korhonen (1984) did not notice them in *L. torminosus* var. *torminosus*, whereas Hesler & Smith found them in *L. torminosus* var. *nordmannensis* (Smith) Hesler & Smith. Whether this will be a useful character for separating the two taxa remains to be seen on fresh material.

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