

Russula suecica, a new red species from Northern Fennoscandia

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Russula suecica, a new species occurring e.g. with species of *Betula*, is described and illustrated. It is known from Finland, Sweden, Norway, Canada, U.S.A. and Russia, from southern boreal zone to low-alpine belt. This species has fairly large fruit bodies, with red pileus, often with cream to whitish splodges, white stipe, often with reddish glimmer, very acrid taste, smell like *Russula emetica*, and creamy-yellow spore print.

Key words: Agaricales, Basidiomycetina, Fennoscandia, *Russula*, Russulales, taxonomy

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Introduction

Many species in the genus *Russula* have red pileus, and therefore the identification of red *Russula* -species is often not easy. Here we add to the group a northern species, *Russula suecica*, which has earlier been provisionally called *Russula chusii* ss. Ruots. (Kytövuori et al. 2005).

Material and methods

Morphology. Spore masses from spore prints were placed between microscope slides, and colours were determined using Romagnesi's codes by the colour chart prepared by Christian Dagron. The measurements of the spores were made excluding ornamentation, and basidia lengths excluding sterigmata. The spores were measured in Melzer's reagent, other elements in 10 % ammoniumhydroxide. 5 % from each end of range of spores are given in parentheses.

Molecular analyses. DNA was extracted from dried material (pieces of lamellae) with the NucleoSpin Plant

kit (Macherey-Nagel, Düren, Germany). Primers ITS 1F and ITS 4 (White et al. 1990, Gardes & Bruns 1993) were used to amplify ITS regions and the same primer pairs were used in direct sequencing. Polymerase chain reaction amplification and sequencing followed Liimatainen et al. (2014).

Data analyses. Sequences were assembled and edited with Sequencher 4.1 (Gene Codes, Ann Arbor, Michigan, USA). For the phylogenetic analysis our own as well as the already published sequences of the genus were included. Using a BLAST query of the public databases (GenBank: <http://www.ncbi.nlm.nih.gov/> and UNITE: <http://unite.ut.ee/>), we checked whether identical or similar sequences were in public databases. *Lactarius trivialis* (Fr.) Fr. (GenBank no. KT165317) and *Lactarius torminosus* (Schaeff.) Gray (GenBank no. KR025613) were used as an outgroup. The ITS alignment of 29 sequences was produced with the program MUSCLE (Edgar 2004) under default settings. The ITS alignment was manually adjusted in Seaview (Galtier et al. 1996). The alignment is composed of 750 nucleotides (including gaps). Sequences were subjected to Maximum Likelihood (ML) analysis as implemented in RAxML version 8 (Stamatakis 2014) with 1000 bootstrap replicates under the GTRGAMMA model. The phylogenetic tree resulting from our RAxML analysis is shown in Fig. 1.

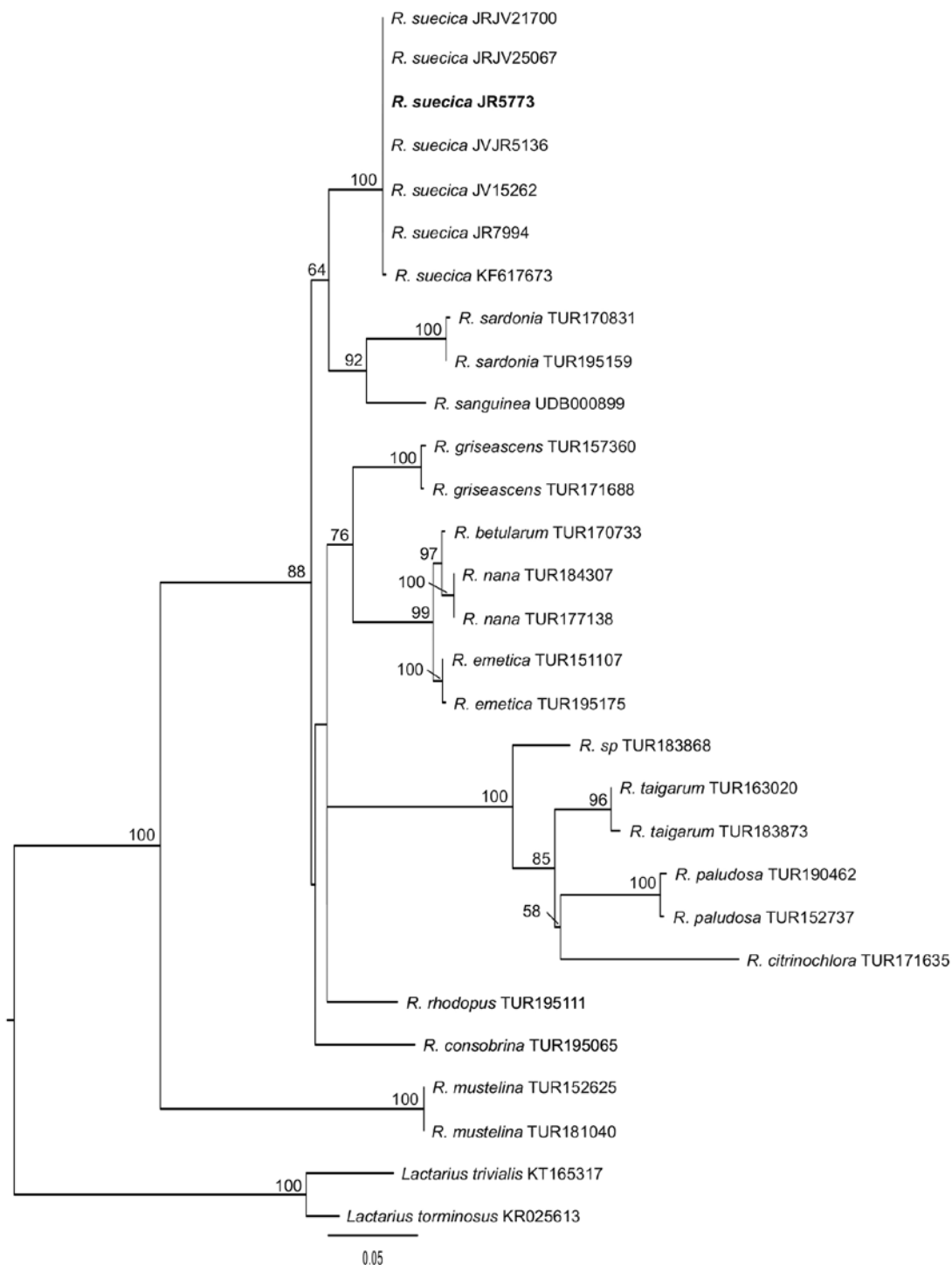


Fig. 1. Phylogram resulting from the RaXML analysis of ITS regions. Bootstrap values greater than 50% are indicated above branches. The sequence of *Russula suecica* originating from the type specimen is in boldface.

Russula suecica Ruots. & Vauras, **sp. nova**
– Figs. 1–5

Mycobank no.: MB 818674

Diagnosis: Medium-sized to large species with red pileus, fading often partly or totally, with often irregular white stipe which can be partly reddish. Taste very acrid. Spores in mass pale crème to crème (IIa–c), $(7.1\text{--})7.8\text{--}9.3\text{--}(9.6) \times (6.4\text{--})6.5\text{--}7.3\text{--}7.9\text{--}(8.2) \mu\text{m}$, mainly subglobose, with reticulum. Dermatozystidia mainly fusiform and often moniliform.

Typus: Sweden. Norrbotten. Övertorneå, Pello, W of Neistenkangas, near Yli-Tankovaara, moist brookside forest with *Picea abies*, *Betula* and *Pinus sylvestris*, alt. ca 110 m a.s.l., ca 66°47'30" N, 23°47'30" E, 9.VIII.2001 Ruotsalainen 5773F (KUO – holotype; GB, TUR-A – isotypes, GenBank no. KX099962).

Etymology: the species is dedicated to the memory of our late friend Juhani Ruotsalainen (his Finnish family name means “Swedish”, hence “*suecica*”). The holotype specimen selected also originates from Sweden.

Pileus 3–12 cm in diam, at first plano-convex to convex, sometimes with low umbo, later expanded and depressed, often somewhat irregular, margin deflexed, often undulate, blunt, first smooth, later slightly sulcate; scarlet, but mostly not as intensive as *R. emetica* or *R. nana*, often darkest at centre, pale red, sometimes already when young with pale areas, later, when washed-out, with whitish, crème, pale brownish and/or pale greenish colors, surface when moist viscid, when dry mostly shiny, not pruinose, ca half of pileipellis peeling. **Lamellae** up to 10 mm broad, moderately crowded, adnate to subdecurrent, at first white, then cream-white, later cream-yellow to pale yellow, with some shade of greyish, with many bifurcations and lamellulae, fragile, taste very acrid. **Stipe** 3–11 \times 1.2–3 cm, subclavate or thickest at the middle, often irregular and with knobs, longitudinally somewhat rugose, not pruinose, not hollow inside; when young white or often partly reddish, later somewhat greyish and with yellow-brown to brown patches. **Context** white to whitish to weakly yellowish, when old partly yellow-brown, under pileipellis pale red, fairly soft; taste acrid to very acrid. **Odour** fruity or somewhat like in cocoa (like *R. emetica*).

Spores in mass pale crème to crème (Romagnesi IIa–c), $(7.1\text{--})7.8\text{--}8.5\text{--}9.3\text{--}(9.6) \times (6.4\text{--})6.5\text{--}7.3\text{--}7.9\text{--}(8.2) \mu\text{m}$, total range of mean values 7.9–8.8 \times 7.0–7.6 μm , $Q = (1.05\text{--})1.1\text{--}1.17\text{--}1.25\text{--}(1.3)$, total range of mean Q values 1.13–1.20 (140 spores from 7 collections); subglobose to broadly ellipsoid, amyloid, with rather dense, \pm complete reticulum, warts up to 0.8 μm long, blunt, plage amyloid. **Basidia** 32–45 \times 7–10 μm , clavate, 4-spored. **Hymenial cystidia** 8–11 μm broad, blunt to appendiculate. **Pileipellis:** apical cells 2–4 μm broad, clavate to cylindrical, dermatozystidia 4–7 μm broad, 0–3(–7) septate, mainly fusiform, often moniliform and with appendix, a part cylindrical, some subclavate, without encrusted elements, fairly scarce to moderately numerous. In the ITS regions *R. suecica* is distinct from other known *Russula* species and differs from *R. sardonica* Fr. and *R. sanguinea* Fr. over 45 substitutions and indel positions (> 7 %).

Russula suecica has a wide distribution in Fennoscandia. In Sweden and Finland it has a north-oriented distribution with occurrences mainly in middle and northern boreal zone, and also in or-arctic zone. In Norway the southernmost localities are near the limit of the hemiboreal (bore-onemoral) zone, but on higher altitude. Further, the species is known from Northern Russia and low arctic tundra of Canada.

In boreal forests *Russula suecica* grows often in fairly old mixed forests dominated by *Picea abies*, very often on foots of slopes of hills, on bottoms of gorges, at margins of paludified brooksides, at margins of bogs, also in *Sphagnum* or close to it. These forest sites have rather cool soils. Further, it grows in subalpine birchwoods of *Betula pubescens* subsp. *czerepanovii*, and in low-alpine belt, where it can be found amongst *Betula nana*. In Russia it has been collected from mossy heath tundra near *Betula nana* and *Salix*, in Canada in low arctic tundra with e.g. *Salix arctica* and *S. herbacea*, but also with *Rhododendron* and *Arctostaphylos*, without any *Salix* or *Betula* nearby. According to data in GenBank and UNITE Database it occurs in Canada and U.S.A., Alaska with e.g. *Betula nana* and *Salix arctica*. According to this data the species has a broad distribution. Maybe it is not a rare species, because it seems not to be particularly demanding.

The fruiting period of *R. suecica* starts in early August, reaches the maximum in mid-August – late August, and ceases in mid-September.



Fig. 2. *Russula suecica*, holotype (Ruotsalainen 5773F). Photo: J. Ruotsalainen.



Fig. 3. *Russula suecica*, Norway, Troms, Storfjord, Lulledalen, 17.VIII.2004 Ruotsalainen & Vauras 21700F.
– Photo: J. Vauras.

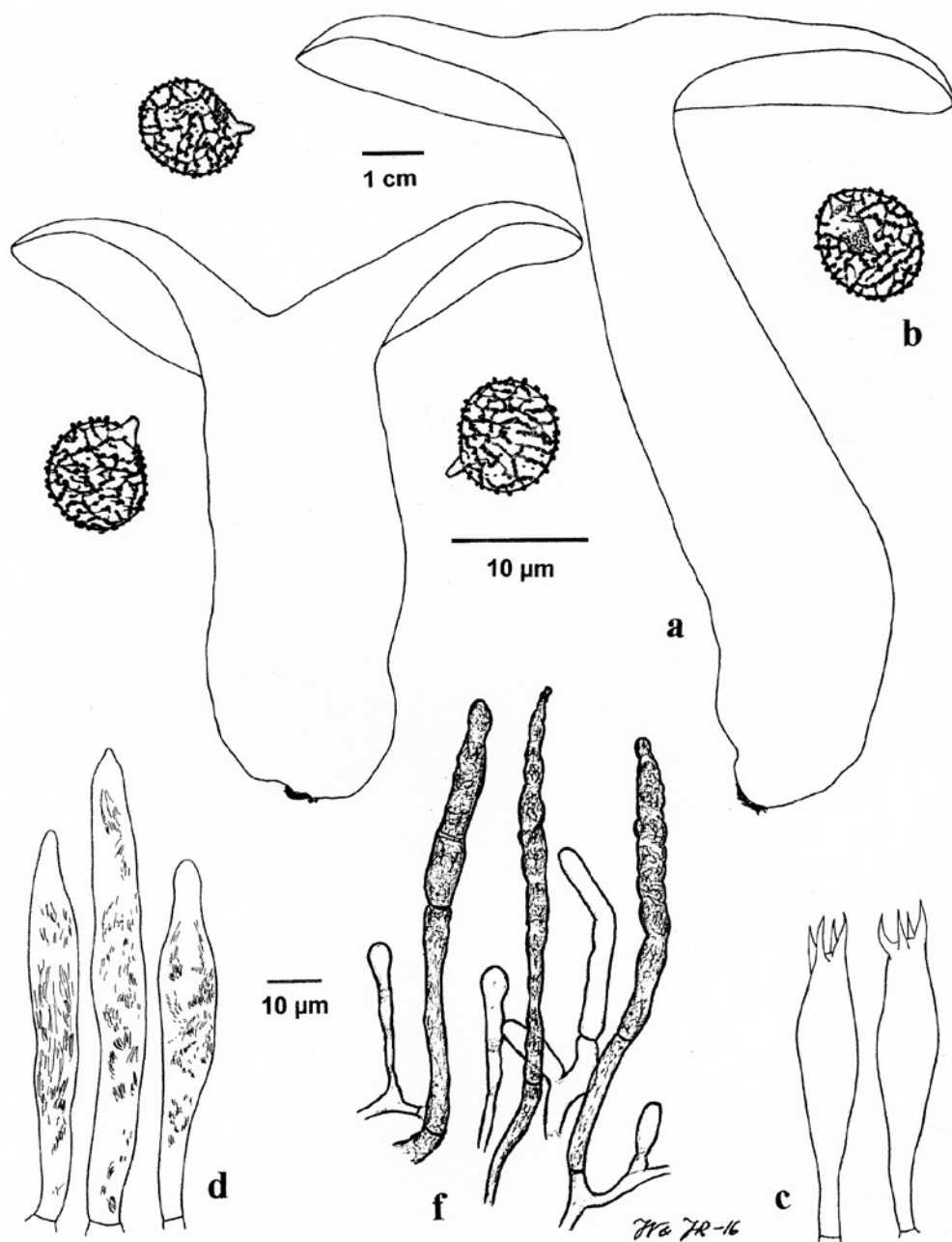


Fig. 4. *Russula suecica*. Cross-sections of fruit bodies (a) and microscopical characters (b = spores, c = basidia, d = hymenial cystidia, e = elements of pileipellis). All from holotype but cross-sections from Ruotsalainen & Vauras 21700F.

Other specimens studied: **CANADA.** **Nunavut.** Baker Lake, ca. 2 km NE of the settlement, 14.VIII.1974 /5 *Ohenoja* (OULU), ca 2 km NNW of the settlement, 18.VIII.1974 /96 *Ohenoja* (OULU); Rankin Inlet, Kudlulik Peninsula, near NW end of the airstrip, 21.VIII.1971 /36 *Ohenoja* (OULU). **FINLAND.** **Pohjois-Häme.** Konnevesi, Hytölä, Myllykorpi, 6.IX.2002 *Ruotsalainen* 6129 (KUO). **Pohjois-Savo.** Kuopio, Neulaniemi, 23.VIII.1980 *Vauras* 722 (TUR-A), 10.VIII.1988 *Heikkilä, Vauras & Ruotsalainen* 1046F (KUO), 11.VIII.1994 *Vauras & Ruotsalainen* 3521 (KUO); Nilsia, Tahkomäki, Huutavanholma, 4.IX.1994 *Aho & Ruotsalainen* 3748 (KUO), 17.VIII.1998 *Ruotsalainen* 4765F (KUO), 17.VIII.1999 *Aho & Ruotsalainen* 5194 (KUO); Leppävirta, Mustinmäki, Orinoro, 19.VIII.2000 *Ruotsalainen* 5580 (KUO), 19.VIII.2001 *Ruotsalainen* 5817 (KUO). **Pohjois-Karjala.** Liperi, Leppälahti, 28.VIII.1994 *Höijer* 1269 (KUO), Siikasaari, 27.VIII.1994 *Ruotsalainen* 3684 (KUO, TUR-A). **Oulun Pohjanmaa.** Pudasjärvi, Iinattijärvi, Ohtavaara, 22.VIII.1997 *Ohenoja* (OULU, H). **Perä-Pohjanmaa.** Rovaniemi, Pahtaja, 21.VIII.1999 *Kuusela* (TUR-A), Sinettä, near Pohtimolampi, 2.IX.2013 *Kytövuori* (KUO), Taipale, Kalkkimaa, 21.VIII.1999 *Vauras* 15262 (TUR-A; UNITE no. UDB022609); Tuhnaja, Kiimamaa, 6.IX.2013 *Ruotsalainen* 9092 (KUO, TUR-A). **Koillismaa.** Kuusamo, Hiltunen, Iivaara, E slope, 29.VIII.2007 *Ruotsalainen & Vauras* 25067 (TUR-A, UNITE no. UDB022610), Kouervaaara, 23.VIII.1997 *Ruotsalainen* 4430 (KUO), Oulanka National Park, Jäkälävaara, 21.VIII.1997 *Ruotsalainen* 4397, 4407 (KUO), 30.VIII.1998 *Ruotsalainen* 4782F (KUO), 26.VIII.2002 *Ruotsalainen* 6087 (KUO), Nurmisaarenniemi, 23.VIII.2007 *Vauras* 24948 (TUR-A), 27.VIII.2007 *Alpago-Novello* (KUO), Salminen, 23.VIII.1997 *Ruotsalainen* 4423 (KUO, TUR-A), Vuotunki, Kuntivaara, 2.IX.2005 *Ruotsalainen* 7105 (KUO, O). **Kittilän Lappi.** Kolari, Teuravuoma, 6.VIII.1986 *Ruotsalainen* 257F (KUO, TUR-A). **Sompion Lappi.** Sodankylä, Luosto, Luostonloma, 27.VIII.2008 *Vauras & Ruotsalainen* 7756 (KUO), Urho Kekkonen National Park, Pyhä-Nattanen, 23.VIII.1990 *Kytövuori* 90-588 (H). **Enontekiön Lappi.** Enontekiö, Kaaresuvanto, 11.VIII.1985 *Vauras & Ruotsalainen* 64 (KUO); Kilpisjärvi, Goalarrassa, 14.VIII.1990 *Vauras & Ruotsalainen*

1783 (KUO); Pikku-Malla, 9.VIII.1986 *Vauras & Ruotsalainen* 283b (TUR-A), Possovárri, 20.VIII.2014 *Lahti* (KUO), Siilasvuoma, 25.VIII.2014 *Ruotsalainen* 9202 (KUO). **NORWAY.** **Akershus.** Nittedal, Åneby, 25.VIII.2000 *Eggen* (TUR-A). **Buskerud.** Ringerike, Hönefoss, Grunntjern, 28.VIII.2003 *Ruotsalainen* 6361b (KUO), 16.VIII.2006 *Marstad* 122-09 (O). **Sör-Trøndelag.** Åtfjord, Stordalen, Latanger, 4.IX.2009 *Ruotsalainen* 8002 (KUO). **Nord-Trøndelag.** Steinkjer, Mokka, 3.IX.2009 *Ruotsalainen* 7994 (H, KUO, GenBank no. KX988014). **Troms.** Storfjord, Bossovarri near border of Finland, *Campo & Lahti* 57/14 (TUR), Lulledalen, 17.VIII.2004 *Ruotsalainen & Vauras* 21700F (TUR-A, KUO, GenBank no. KX988015), 22.VIII.2014 *Ruotsalainen* 9176 (KUO), Övrevatnet, 19.VIII.2004 *Ruotsalainen* 6649 (KUO). **RUSSIA. Tumen Region.** Yamalo-Nenetsia, E part of Bolshemelska Tundra, W of the estuary of Talatayakha River, 20.VIII.1996 *Ohenoja* (OULU). **SWEDEN. Ångermanland.** Säbro, Håltjärnsberget, 27.VIII.1997 *Kytövuori* (KUO). **Lule lappmark.** Jokkmokk, Padjelanta National Park, Svartinjunjes, 19.VIII.2016 *Vauras* 31586F (TUR-A, GB). **Norrbotten.** Övertorneå, Pello, 12.VIII.1999 *Vauras & Ruotsalainen* 5136F (KUO, TUR-A, GenBank no. KX099961), 21.VIII.2016 *Vauras* 31629 (TUR-A). **Torne lappmark.** Jukkasjärvi, Björkliden, 17.VIII.1999 *Ruotsalainen* 5161 (KUO), Riksgränsen, 26.VIII.2016 *Campo* (TUR-A).

Discussion

As a red-capped species *Russula suecica* is not very easy to recognize in the nature. According to its macroscopical and microscopical characters the species belongs to subsection *Sardoninae* Singer. Among them it could be taken as e.g. *R. rhodopus* Zvara, *R. helodes* Melzer, *R. renidens* Ruots., Sarnari & Vauras or *R. depallens* (Pers.: Fr.) Fr. These species have somewhat darker spores in mass. Further, *R. rhodopus* is a species growing with *Picea abies*. Its spores have not as dense and complete reticulum, and they are somewhat smaller. *R. helodes* seems to be a rare or very rare species in the Nordic countries. It has larger spores than *R. suecica*. *R. renidens* grows on wet sites with *Betula*. Its pileus has different tone of red, i.e. blood red to violaceous

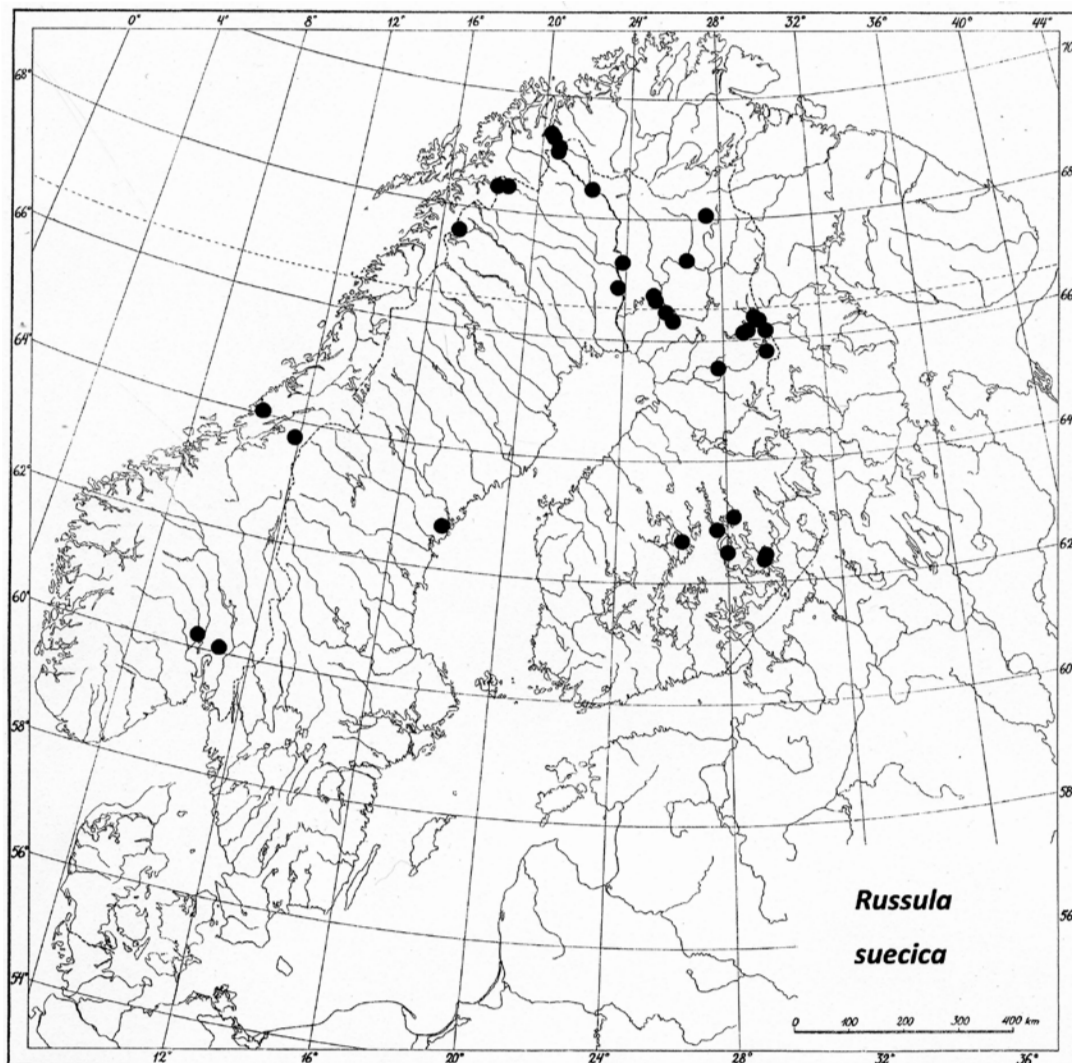


Fig. 5. Distribution of *Russula suecica* in Fennoscandia, according to the material examined.

purple, and spores are verrucose, with some connections. *R. depallens* grows with *Betula* on dry calcareous grounds, as at roadsides. Its spores are not as reticulated as in *R. suecica*.

Russula suecica somewhat resembles also *R. emetica* (Schaeff.: Fr.) Pers., *R. nana* Killerm. and *R. griseascens* (Bon & Gaugué) Marti, all members of subsection *Russula* (= *Emeticinae* Melzer & Zvara ss. Romagnesi; Sarnari 1998). These species are somewhat smaller than *R. suecica*, and their spores are in mass white to

whitish. *R. emetica* and *R. nana* have bright-red pileus and white stipe. *R. griseascens* has a gray-ing stipe, rarely with a pink tinge. For more characters of the species used in comparison with *R. suecica* we refer to Sarnari (1998).

The name *Russula clusii* Fr. is difficult to interpret (Sarnari 1998). Fries (1838) gives a very short description, cites some older literature and states: "Mihi parum cognate." (= a species too little known by me). At the moment we prefer to regard this as a dubious name.

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