New northern records of *Entoloma* with three new species of subgenus *Rhodopolia* and typification of *E. nidorosum*

Katri Kokkonen

Abstract

Three hemiboreal or boreal species of *Entoloma* subg. *Rhodopolia*, *E. flaviale*, *E. quercetorum* and *E. uvidicola*, are described as new based on molecular and morphological data. *Entoloma nidorosum* is neotypified. New records of *E. boreale*, *E. caeruleopolitum*, *E. holmvasdalenense*, *E. lupinum*, *E. paragaudatum*, *E. pseudoconferendum*, *E. radicipes*, *E. rhodopolium* and *E. sphagneti* are presented from Finland and Sweden with ecological and morphological notices.
Introduction

The genetic research of boreal Entoloma subg. Rhodopolia (Agaricales, Basidiomycota) has revealed many more species than previously assumed (Kokkonen 2015; Brandrud et al. 2018). The species are morphologically difficult to distinguish from each other. The species around E. rhodopolium (Fr.) Quél. have been particularly difficult, which situation has been improved by the neotypification of E. rhodopolium (Kokkonen 2015). The aim of this study was to further clarify the species identities and stabilize the nomenclature. Entoloma nidorosum (Fr.) Quél. is neotypified, and two species genetically close to E. rhodopolium and E. nidorosum, as well as a species close to E. sericatum (Britzelm.) Sacc., are described as new. To provide data about distributions and habitats, new records of rarely reported Entoloma species are presented from Finland and Sweden.

Materials and Methods

For the typification of E. nidorosum, specimens of the herbarium of Museum of Evolution, Uppsala (UPS) were examined. Additionally, E. nidorosum and other Rhodopolia were searched from some forests around Uppsala during two days in the beginning of October, 2019. The descriptions of all new species are based on my own collections from 2006 to 2020. Vegetation was observed at the collection sites, and macroscopic features were noted from fresh fruitbodies. The colour codes refer to Küppers (1999). Few specimens of the herbarium of University of Turku (TUR) were among the material of E. quercetorum Kokkonen. The examined specimens are deposited in TUR, unless otherwise stated.

The microscopic and molecular methods follow Kokkonen (2015), except that both NucleoSpin Tissue XS and Plant II kits (Macherey-Nagel) were used for the DNA extraction. In addition to ITS (internal transcribed spacer) gene region, RPB2 (RNA polymerase II subunit) gene region was sequenced and analysed for E. fluviale Kokkonen and E. quercetorum. The sequences were submitted to European Nucleotide Archive (ENA). The ENA numbers are provided in Table 1. All sequenced specimens have been marked with * along the descriptions.

For the phylogenetic analysis of Rhodopolia specimens, the ITS sequences were aligned by MAFFT 7.0 (Katoh 2013) and the alignments adjusted manually in AliView (Larsson 2014). The alignment is available as Electronic Supplementary Material 1. The maximum likelihood (ML) tree was run by raxmlGUI 2.0 (Stamatakis 2014; Edler et al. 2019) with thorough bootstrap, 1000 bootstrap replicates, and GTR+I model. The Bayesian analysis was performed with MrBayses 3.2.6 (Ronquist and Huelsenbeck 2003) with GTR + I model, 500000 generations, samplefreq 500, printfreq 500 and diagnfreq 1000. The resulting tree was edited in TreeGraph 2 (Stöver & Müller 2010).

Taxonomy

Entoloma nidorosum (Fr.) Quél., Mém. Soc. Émul. Montbél., Sér. 2, 5: 119 (1872) – Agaricus nidorosus Fr., Epicr. Syst. Mycol. (Upsaliae): 148 (1838) – Figures 1–3

NEOTYPE (designated here): Sweden, Uppland, Knivsta, Nysätra, coniferous forest, 9.IX.1982 coll. & det. Svengunnar Ryman 7056 (UPS F-790006), MycoBank MBT10000874.

SPIORES 7.0-8.2-9.0 × 6.0-6.9-7.7 μm, Q=1.07-1.18-1.32 (n=20), usually subsisodiometrical. BASIDIA 36-47 × 8.5-11 μm (n=9), 4-spored. CYSTIDIA not observed. PILEIPELLIS hyphae smooth or slightly encrusted, with internal diffuse brown pigment; terminal cells cylindrical, somewhat clavate, or with a tapering apex, wall thin or at apex thickish. CLAMPS present in all structures.

COMMENTS: The herbarium UPS has two E. nidorosum collections and one E. nidorosum? collection from or near Uppsala, Sweden. All were conspecific according to ITS sequences, and one of them was selected as a neotype. They resembled morphologically both the protologue (Fries 1838) and the later drawn plate (Fries 1867, Fig. 3). Two of them were collected from coniferous forests, but in my experience, the species is connected with Betu-
Table 1. Accession numbers and origins of the specimens sequenced in this study.

| Species                     | Specimen          | Origin       | Accession number |
|-----------------------------|-------------------|--------------|------------------|
|                             |                   |              | ITS             | RPB2             |
| *E. caeruleopolitum*        | KK 246/18         | Finland      | OB998028        |                  |
| *E. fluviale*               | KK 8/19, holotype | Finland      | OB998022        | OB998320         |
| *E. fluviale*               | KK 10/19          | Finland      | OB998023        |                  |
| *E. fluviale*               | KK 1153/12        | Finland      | OB998024        |                  |
| *E. fluviale*               | KK 1603/12        | Finland      | OB998025        |                  |
| *E. fluviale*               | KK 190/20         | Finland      | OB998026        |                  |
| *E. fluviale*               | KK 191/20         | Finland      | OB998027        | OB998321         |
| *E. holmvassdalense*        | KK 489/18         | Finland      | OB998029        |                  |
| *E. nidorosum*              | S. Ryman 7056, neotype | Sweden      | OB998030        |                  |
| *E. nidorosum*              | J. Ax. Nannfeldt 10526 | Sweden      | OB998031        |                  |
| *E. nidorosum*              | J. Ax. Nannfeldt 11356 | Sweden      | OB998032        |                  |
| *E. pseudoconferendum*      | KK 137/18         | Finland      | OB998033        |                  |
| *E. quercetorum*            | KK 117/19, holotype | Finland      | OB998034        | OB998322         |
| *E. quercetorum*            | KK 118/19         | Finland      | OB998035        |                  |
| *E. quercetorum*            | KK 122/19         | Finland      | OB998038        |                  |
| *E. quercetorum*            | KK 123/19         | Finland      | OB998036        |                  |
| *E. quercetorum*            | KK 124/19         | Finland      | OB998037        |                  |
| *E. quercetorum*            | KK 128/19         | Finland      | OB998040        |                  |
| *E. quercetorum*            | KK 129/19         | Finland      | OB998039        |                  |
| *E. quercetorum*            | KK 130/19         | Finland      | OB998042        | OB998323         |
| *E. quercetorum*            | KK 132/19         | Finland      | OB998041        |                  |
| *E. rhodopolium*            | KK 258/20         | Finland      | OB998043        |                  |
| *E. sericatum*              | KK 1150/12        | Finland      | OB998044        |                  |
| *E. sericatum*              | KK 1152/12        | Finland      | OB998045        |                  |
| *E. sphagneti*              | KK 138/18         | Finland      | OB998046        |                  |
| *E. uvidicola*              | KK 112/19, holotype | Sweden      | OB998047        |                  |
| *E. uvidicola*              | KK 113/19         | Sweden       | OB998048        |                  |
Fig. 1. *Entoloma nidorosum*, neotype.

Fig. 2. *Entoloma nidorosum*, neotype, microscopic characters. B basidia, P terminal cells of pileipellis, Sp spores.

Fig. 3. *Entoloma nidorosum*, number 3, plate in Fries (1867).
Entoloma uvidicola Kokkonen, sp. nov.

Synonym Entoloma speculum var. microsporum Armada & Lopez, Bull. mycol. bot. Dauphiné-Savoie 226: 6 (2017) MycoBank MB839351

ETYMOLOGY: the epithet refers to the moist habitat.

HOLOTYPE: Sweden, Uppland, Uppsala, Vårdsättra, SE of Norrtorpet, moist mixed forest, near Betula, Picea abies, Alnus glutinosa and Rhamnus frangula, further away Pinus sylvestris, Fraxinus excelsior, Populus tremula and Salix caprea, rich undergrowth with Athyrium filix-femina, Filipendula ulmaria and Vaccinium myrtillus, among leaf litter and hygrophanous mosses like Mnium, 6.X.2019 K. Kokkonen 112/19 (TUR; isotype UPS).

PILEUS 1.5−5.8 cm in diameter; campanulate when young, then planate, low convex or depressed, umbo absent or low, at times margin undulate; greyish brown or yellowish brown (S<sub>30</sub>Y<sub>60</sub>M<sub>50</sub>) with a darker centre (S<sub>50</sub>Y<sub>40</sub>M<sub>30</sub>), or rather dark brown when old (S<sub>50</sub>Y<sub>70</sub>M<sub>50</sub>), at times margin whitish; smooth or slightly radially rugulose when old, slightly viscid or dry, hygrophanous, margin translucently striate. LAMELLAE adnate to short decurrent; moderately or rather densely crowded; pale grey brown or pale grey when young, then with a pink tinge; edge slightly uneven or even, concolorous. STIPE 2.3−8.2 cm long, 0.5−1.2 cm wide; equal or narrowest in the middle, base often clavate or subbulbous, rarely flattened; whitish, pale grey or pale grey brown with a whitish apex; dry, faintly fibrilllose, fistulose. CONTEXT fragile; dark brown grey in pileus, pale grey in stipe. SMELL weakly nitrous, "entolomaceous" (perhaps a mixture of faint nitrous and farinaceous) or indistinct, at times slightly farinaceous when crushed. TASTE indistinct or "entolomaceous".

SPORES (7.4)7.7−8.5−9.8(10.5)×(6.0)6.3−7.0−8.0(8.3) μm, range of mean values 8.3−8.6 × 6.7−7.1 μm, Q=(1.04)1.08−1.23−1.33(1.40), range of mean Q values 1.20−1.25 (60 spores from three collections); usually subsidiometrical or heterodiometrical, at times angles nodulose. BASIDIA 30−36−44 × 9−11−14 μm (n=21), 4- or 2-spored. CYSTIDIA not observed. PILEIPELLIS hyphae hyaline or brownish, some slightly to moderately encrusted; terminal...
cells hyphoid, often with a tapering apex, wall thin or partially thickish. **STIPITIPELLIS:** terminal cells cylindrical or clavate, thin-walled. **CLAMPS** present in all structures.

**HABITAT AND DISTRIBUTION:** Known from three sites in the type forest in Sweden, from Tar-tumaa and Saare in Estonia according to two sequences in UNITE (UDB025069; UDB018017, as *E. rhodopolium*), and from Meyzieu, Rhône in France according to a GenBank sequence (MF882927, Armada & Lopez 2017). The habitat was a moist mixed forest in Sweden and all sites included *Picea abies, Betula, Salix caprea, Populus tremula, Fraxinus excelsior* and *Rhamnus frangula*. The habitat of one Estonian collection is mentioned to be a temperate mixed forest, but the habitats of other collections are unknown.

**COMMENTS:** *Entoloma uvidicola* resembles morphologically species around *E. rhodopolium*. It is also genetically close to them. The nearest species *E. nidorosum* differed by 19 bases and 2 indels, when compared between the types. Two *avidicola* collections deviated by 2 bases from the holotype but all are regarded as conspecific. The type sequence was identical with the type sequence of *E. speculum* var. *microsporum* (Armada & Lopez 2017) excluding ambiguous bases. The morphology of *E. uvidicola* partially agrees with the protologue of *E. speculum* (Fries 1836), but since *E. speculum* was characterized by a white, whitish or 'straw white' pileus when moist, turning silvery when dry, and emarginate lamellae, the identification of Armada & Lopez is disagreed. The pileus of *E. speculum* var. *microsporum* was greyish or yellowish brown with a pink tinge, turning white when drying (Armada & Lopez 2017). Further, the habit of *E. speculum* is different in the plate of Fries (1867). *Entoloma speculum* was common around Femsjö according to Fries (1836), and it is thought to imply whitish forms of *E. sericatum* and maybe also whitish forms of other similar species by the author (Kokkonen 2015). The fungi of Armada &

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Fig. 4. *Entoloma uvidicola*. a holotype. b KK 113/19.

Fig. 5. *Entoloma uvidicola*, holotype, microscopic characters. For symbols see Fig. 2 and 5 terminal cells of stipitipellis.
Lopez (2017) resembled morphologically the Swedish *uvidicola* fungi, but they differed by the pink tinge and on average smaller spores. They were odourless.

*Entoloma uvidicola* is morphologically similar to *E. nidorosum* and *E. rhodopolium*, but it differs from them by having more often or stronger incrustations at pileipellis, and from *E. nidorosum* by a somewhat stouter habit and weaker smell. No species was found to match *E. uvidicola* by the author. *Entoloma rosealbulum* Arnoldis & Noordel. is morphologically rather similar and it also grows in a wet habitat. However, it differs by a differently shaped white pileus, larger spores, and clamps observed only at the hymenium (Noordeloos 2004). *Entoloma leucocarpum* Noordel. differs by a differently shaped white pileus, larger spores, and presence of cheilocystidia (Noordeloos 1981, 1992). Their types were not obtained for loan.

**ADDITIONAL SPECIMENS EXAMINED:** SWEDEN. Uppland. Uppsala, Vårdsätra, SE of Norrtorpet, 8.X.2019 Kokkonen 113/19*, 114/19*.  

**Entoloma quercetorum** Kokkonen, sp. nov  
- Figures 6 and 7  
MycoBank MB839352

**ETYMOLOGY:** The epithet refers to the habitat in *Quercus* forests; the type locality Tammimäki means Oak hill.

**HOLOTYPE:** Finland, Varsinais-Suomi, Turku, Ruissalo, Tammimäki, S slope, herb-rich forest with *Quercus robur*, *Tilia cordata*, *Acer platanoides*, *Corylus avellana* and *Pinus sylvestris*, among leaf litter, Grid 60° 255.668, 022° 09.437, alt. 9 m, 9.X.2019 K. Kokkonen 117/19 (TUR, isotype UPS).

**PILEUS** 1.7–9.2 cm in diameter; planate, depressed or low convex, rarely campanulate, umbo low or absent, margin usually even or weakly undulate, at times deflexed; yellow brown, grey brown or pale brown (*S*~4~*Y*~30~*M*~40~*−*~60~*S*~50~*Y*~70−80~*−*~100~*M*~*−*~40~*−*~60~ *ca. S*~40~*Y*~50−60~*M*~*−*~40~*−*~60~ *S*~50~*Y*~70−80~*−*~100~*M*~*−*~40~*−*~60~), centre usually darker (*ca. S*~4~*Y*~50−60~*M*~*−*~40~*−*~60~ *S*~50~*Y*~70−80~*−*~100~*M*~*−*~40~*−*~60~) and margin paler; smooth or rarely scarce fibrillose, dry or slightly viscid, rarely centre rugulose or cracked to squamules, hygrophanous, margin translucently striate. **LAMELLAE** up to 9 mm, often rather broad; adnate, emarginate or subdecurrent; usually moderately crowded; at times transvenose; pale grey or pale grey brown when young, then with a pink tinge (*ca. S*~2~*0~*Y*~10−30~*−*~40~*M*~*−*~40~*−*~60~ *S*~50~*Y*~70−80~*−*~100~*M*~*−*~40~*−*~60~ *ca. S*~2~*0~*Y*~30−40~*M*~*−*~40~*−*~60~ *ca. S*~2~*0~*Y*~30−40~*M*~*−*~40~*−*~60~ *ca. Y*~50−60~*M*~*−*~60~); edge slightly uneven or even, concolorous. **STIPE** 3.1–8.7 cm long, 0.35–1.0 cm wide; equal or broadening towards the base, base roundish, tapering or rarely subbulbous; white, pale grey brown, or grey brown, usually darker when old or down the stipe; dry, faintly fibrillose, often somewhat shiny especially when young, apex not or short pruinose, fistulose at least when old. **CONTEXT** fragile to rather firm; in pileus dark brown grey or dark grey brown; in stipe pale grey, pale grey brown or darker grey brown. **SMELL** spontaneously faintly aromatic especially when old, indistinct, or "entolomaceous"; when crushed slightly farinaceous or indistinct. **TASTE** indistinct, slightly farinaceous, or "entolomaceous".  

**SPORES** (6.8)7.4–9.2(10.2) × (6.0)6.4–7.2–8.0(8.6) µm, range of mean values 7.9–8.4 × 7.1–7.5 µm, Q=(1.00)1.04–1.13–1.24(1.30), range of mean Q values 1.10–1.16 (200 spores from 10 collections); mostly sub-isodiametrical with 5–6 angles. **BASIDIA** 27–36–67 × 8–10–12 µm (n=60), 4-spored. **CYSTIDIA** not observed.  

**PILEIPELLIS** hyphae hyaline or brownish, some slightly to moderately encrusted; terminal cells cylindrical, fusoid or clavate, usually long, wall thin or at apex thickish. **STIPITIPPELLIS:** terminal cells usually cylindrical or clavate, long to short, rarely short utriform, fusiform or roundish and forming chains, wall thin or thickish, often as tight bundles.

**HABITAT AND DISTRIBUTION:** Herb-rich forests with *Quercus robur*, likely connected at least with *Quercus*, also *Tilia cordata* and *Corylus avellana* often present in Finland, common in *Quercus* forests of south-west Finland. According to GenBank sequences, mycorrhizal with Mediterranean *Quercus ilex* (HQ204653, Richard et al. 2011) and with *Pinus sylvestris* from serpentine soil in Austria (EU046031, Urban et al. 2008).  

**COMMENTS:** *Entoloma quercetorum* is genetically and morphologically close to *E. rhodopolium*. The types differed by 14 bases and 2 indels in ITS and 13 bases in RPB2 sequences from each other. They seem to have different hosts: *E. quercetorum* growing at least with *Quercus*, whereas *E. rhodopolium* with *Fagus* and some other deciduous trees. They were not found from the same sites. Morphologically, *E.
*Entoloma quercetorum* is distinguishable by the slight aromatic smell, when present, and the distinctly encrusted hyphae of pileipellis. *Entoloma nidorosum* is also close: the ITS sequences of the types differed by 19 bases and 2 indels from each other. It is also morphologically similar but usually has a depressed pileus with undulate margin, nitrous smell, and smooth or only very slightly encrusted pileipellis hyphae. It grows with *Betula* at moist sites. Generally, several large species of subg. *Rhodopolia* resemble each other, but none were found to grow with *E. quercetorum* in the same habitat.

**ADDITIONAL SPECIMENS EXAMINED:** FINLAND. Varsinais-Suomi. Kaarina, Vaarniemi nature reserve, W slope, herb-rich forest dominated by *Quercus robur*, near *Quercus* and *Acer platanoides*, 13.X.2019 Kokkonen 128/19*. Parainen, Lenholm,

![Fig. 6. Entoloma quercetorum. a holotype. b KK 129/19. c KK 124/19. d KK 123/19.](image)

![Fig. 7. Entoloma quercetorum, microscopic characters. Holotype: spores, basidia, terminal cells of pileipellis below the symbol, two terminal cells of stipitpellis on the right. KK 118/19: two terminal cells of pileipellis in the middle, two terminal cells of stipitpellis on the left. KK 120/19: two terminal cells of pileipellis above. For symbols, see Figs. 2 and 5.](image)
Entoloma fluviale Kokkonen, sp. nov.

MycoBank MB839353

ETYMOLOGY: the epithet refers to the habitat on riverbanks.

HOLOTYPE: Finland, Sompion Lappi, Savukoski, E of Maskaisenjärvi, S side of the river Värriöjoki, sandy riverbank beside a mixed heath forest, near Salix phylicifolia, Pinus sylvestris, Picea abies, Betula, Sorbus aucuparia, Linnaea borealis and Vaccinium vitis-idaea, 18.VIII.2019 K. Kokkonen 119/19, NE of the Pursiseura house, herb-rich forest with Quercus, Corylus, Betula and Acer, 9.X.2019 Kokkonen 118/19*, Tammiimäki, 10.IX.2006 Kokkonen 684/06*, 28.VII.2007 Kokkonen 24/07*, 9.X.2019 Kokkonen 119/19, 120/19*.

PILEUS 2.3–5.7 cm in diameter; applanate with the epithet refers to the habitat on

Entoloma fluviale Kokkonen, sp. nov.

MycoBank MB839353

ETYMOLOGY: the epithet refers to the habitat on riverbanks.

HOLOTYPE: Finland, Sompion Lappi, Savukoski, E of Maskaisenjärvi, S side of the river Värriöjoki, sandy riverbank beside a mixed heath forest, near Salix phylicifolia, Pinus sylvestris, Picea abies, Betula, Sorbus aucuparia, Linnaea borealis and Vaccinium vitis-idaea, 18.VIII.2019 K. Kokkonen 119/19, NE of the Pursiseura house, herb-rich forest with Quercus, Corylus, Betula and Acer, 9.X.2019 Kokkonen 118/19*, Tammiimäki, 10.IX.2006 Kokkonen 684/06*, 28.VII.2007 Kokkonen 24/07*, 9.X.2019 Kokkonen 119/19, 120/19*.

PILEUS 2.3–5.7 cm in diameter; applanate with the epithet refers to the habitat on riverbanks.

ENTOLOMA FLUVIALE

MycoBank MB839353

ETYMOLOGY: the epithet refers to the habitat on riverbanks.

HOLOTYPE: Finland, Sompion Lappi, Savukoski, E of Maskaisenjärvi, S side of the river Värriöjoki, sandy riverbank beside a mixed heath forest, near Salix phylicifolia, Pinus sylvestris, Picea abies, Betula, Sorbus aucuparia, Linnaea borealis and Vaccinium vitis-idaea, 18.VIII.2019 K. Kokkonen 119/19, NE of the Pursiseura house, herb-rich forest with Quercus, Corylus, Betula and Acer, 9.X.2019 Kokkonen 118/19*, Tammiimäki, 10.IX.2006 Kokkonen 684/06*, 28.VII.2007 Kokkonen 24/07*, 9.X.2019 Kokkonen 119/19, 120/19*.

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PILEUS 2.3–5.7 cm in diameter; applanate with the epithet refers to the habitat on riverbanks.

ENTOLOMA FLUVIALE

MycoBank MB839353

ETYMOLOGY: the epithet refers to the habitat on riverbanks.

HOLOTYPE: Finland, Sompion Lappi, Savukoski, E of Maskaisenjärvi, S side of the river Värriöjoki, sandy riverbank beside a mixed heath forest, near Salix phylicifolia, Pinus sylvestris, Picea abies, Betula, Sorbus aucuparia, Linnaea borealis and Vaccinium vitis-idaea, 18.VIII.2019 K. Kokkonen 119/19, NE of the Pursiseura house, herb-rich forest with Quercus, Corylus, Betula and Acer, 9.X.2019 Kokkonen 118/19*, Tammiimäki, 10.IX.2006 Kokkonen 684/06*, 28.VII.2007 Kokkonen 24/07*, 9.X.2019 Kokkonen 119/19, 120/19*.

PILEUS 2.3–5.7 cm in diameter; applanate with the epithet refers to the habitat on riverbanks.

ENTOLOMA FLUVIALE

MycoBank MB839353

ETYMOLOGY: the epithet refers to the habitat on riverbanks.

HOLOTYPE: Finland, Sompion Lappi, Savukoski, E of Maskaisenjärvi, S side of the river Värriöjoki, sandy riverbank beside a mixed heath forest, near Salix phylicifolia, Pinus sylvestris, Picea abies, Betula, Sorbus aucuparia, Linnaea borealis and Vaccinium vitis-idaea, 18.VIII.2019 K. Kokkonen 119/19, NE of the Pursiseura house, herb-rich forest with Quercus, Corylus, Betula and Acer, 9.X.2019 Kokkonen 118/19*, Tammiimäki, 10.IX.2006 Kokkonen 684/06*, 28.VII.2007 Kokkonen 24/07*, 9.X.2019 Kokkonen 119/19, 120/19*.

PILEUS 2.3–5.7 cm in diameter; applanate with the epithet refers to the habitat on riverbanks.

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E. fluviale deviated at least by 6 bases from all sericatum sequences.

Entoloma leucocarpum Noordel. resembles E. fluviale morphologically and by the habitat on sand (Noordeloos 1981, 1992). It differs by a paler pileus, a weaker umbo, a bulbous stipe base, on average larger spores, and absent incrustations at pileipellis. Its type was not obtained for loan.

ADDITIONAL SPECIMENS EXAMINED:
E. fluviale: FINLAND. Sompion Lappi. Savukoski, E of Maskaisenjärvi, S bank of the river Värriöjoki, 18.VIII.2019 K. Kokkonen 7/19*, 10/19*. Koillismaa. Kuusamo, Oulanka National Park, S of Nurmisarenrinne, bank of the river Oulankajoki, rich vegetation with scattered S. phylicifolia, S. myrsinifolia, Betula, Alnus incana, Prunus padus, Sorbus aucuparia and Picea abies, 9.IX.2012 Kokkonen 1153/12*, 1603/12*, 27.VIII.2020 Kokkonen 189/20, 190/20*, 191/20*.

E. sericatum: FINLAND. Koillismaa. Kuusamo, Oulanka National Park, S of Nurmisarenrinne, bank of

Fig. 8. Entoloma fluviale. a holotype. b KK 7/19. c KK 10/19. d KK 190/20.

Fig. 9. Entoloma fluviale, microscopic characters. Holotype: spores, basidia, five terminal cells of pileipellis above, four terminal cells of stipitpellis on the right. KK 7/19: cheilocystidia left from the symbol. KK 10/19: cheilocystidia right from the symbol. KK 191/20: two terminal cells of pileipellis below. KK 1603/12: two terminal cells of stipitpellis on the right. For symbols, see Figs. 2 and 5.
New records of Entoloma from Finland or Sweden

**Entoloma boreale** Kokkonen, Mycol Prog 14: 116 (2015)

Common in *Picea abies* dominated rich forests of eastern Finland.

**Entoloma caeruleopatulum** Noordel. & Brandt-Ped., Persoonia 12(3): 221 (1984)

FINLAND. Kainuu. Hyrynsalmi, Pieni Mäntymäki, clearing, near seedlings of *Betula* and *Picea abies*, *Vaccinium myrtillus*, and *V. vitis-idaea*, among grasses, *Sphagnum* and other mosses, 4.IX.2018 Kokkonen 246/18*.

The first record from Finland. Pileus 1.6–2.0 cm in diam. Lamellae distant, brown. Stipe 4.0–4.1 × 0.3-0.6 cm, pale grey brown. Smell farinaceous when cut. Spores 7.8–9.2–11.0 × 6.7–7.6–8.9 μm with Q=1.04–1.21–1.38 (n=20), heterodiametrical or subsidometrical, multi-angled with 7–11 angles. Pileipellis hyphae with abundant brown intracellular pigment.

**Entoloma holmvassdalenense** Eidissen, Lorås & Weholt, Öst. Z. Pilzk. 23: 58 (2014)

FINLAND. Kainuu. Paltamo, Kives-Keräsenvaara nature reserve, moist and rich depression along slope with mixed forest, near *Populus*, *Picea*, *Betula*, *Alnus*, *Sorbus*, *Oxalis acetosella*, *Vaccinium myrtillus*, *Rubus saxatilis*, *Geranium sylvaticum*, *Gymnocarpium dryopteris* and *Athryum filix-femina*, 6.VIII.2020 Kokkonen 239/20*.

The first record from Sweden. As an addition to the protologue (Kokkonen 2015), the pileus may have a prominent umbo (the Swedish collections and one Finnish fruitbody) and rarely a yellowish hue (another Swedish collection).

**Entoloma paragaudatum** Kokkonen, Mycol Prog 14: 116 (2015)

FINLAND. Etelä-Häme. Heinola, Läpiä, mixed herb-rich forest, 10.IX.2016 Kokkonen 669/16*. Pohjois-Karjala. Nurmes, Valtimo, Koppelovaara, moist...
herb-rich forest, near Betula, Picea abies, Alnus incana and Salix spp., 4.IX.2016 Kokkonen 393/16*. Kainuu. Paltamo, Yöinnunkuru nature reserve, herb-rich forest, near Picea, Betula, Pinus sylvestris, Salix caprea, Oxalis acetosella, Maianthemum bifolium, Gymnocarpium dryopteris, Geranium sylvaticum, Vaccinium myrtillus and Rubus saxatilis, 8.VIII.2020 Kokkonen 31/20*. Sotkamo, Lauottolampi nature reserve, mixed herb-rich forest, near Salix phylicifolia, Betula, Picea, Pinus, Juniperus communis, Filipendula ulmaria, Geranium sylvaticum, Epilobium angustifolium, Gymnocarpium dryopteris, Daphne mezereum and Crepis paludosas, 16.VIII.2020 Kokkonen 53/20*.

As an addition to the protologue (Kokkonen 2015), the pileus was rarely scarcely fibrillose and extended to 6.8 cm in diameter. Two collections were from moist habitats but not from Sphagnum.

*Entoloma pseudoconferendum* Noordel. & Wölfel, In Noordel., Entoloma s.l., Suppl.: 955 (2004)

FINLAND. Keski-Pohjanmaa. Sievi, Pesäneva, mesotrophic – eutrophic fen, near Rhyynchospora fusca and Menyanthes trifoliata, among Sphagnum, 1.IX.2018 Kokkonen 137/18*.

The first record from Finland. A solitary fruit-body. Pileus 1.7 cm in diam., rather dark brown. Stipe 4.4 × 0.4 cm, brownish. Smell farinaceous when cut. Spores 9.0–9.9–10.5 × 7.4–7.6–8.3 μm with Q=1.21–1.29–1.38, heterodiametrical with 7–8 angles. Pileipellis hyphae with brown intracellular pigment, rarely slightly encrusted.

*Entoloma radicipes* Kokkonen, Mycol Prog 14: 116 (2015)

FINLAND. Pohjois-Karjala. Juuka, margin of Koivikko nature reserve, mixed herb-rich forest, near Picea abies, Salix caprea, Alnus incana, Betula, Sorbus aucuparia and Lonicera xylosteum, 5.IX.2017 Kokkonen 148/17*, Kusilampi nature reserve, herb-rich forest on a steep slope, near Picea, Betula, Sorbus, Lonicera and Actaea spicata, 5.IX.2017 Kokkonen 144/17*, Ruokolanvaara, mixed herb-rich forest, near Picea, Alnus, Betula, Populus tremula, Oxalis acetosella, Equisetum sylvaticum, Geranium sylvaticum, Rubus saxatilis, Filipendula ulmaria, Gymnocarpium dryopteris and Vaccinium myrtillus, 28.VIII.2017 Kokkonen 52/17*, near Salix caprea, Picea, Populus and Lonicera, 5.IX.2017 Kokkonen 143/17*. Nurmes, Valtimo, Koppelovaara, herb-rich forest dominated by Picea, near Picea, Betula, Pinus sylvestris, Oxalis acetosella, Maianthemum bifolium and Gymnocarpium dryopteris, 4.IX.2016 Kokkonen 389/16*.

Like the previous collections from one locality (Kokkonen 2015), all were characterized by a rooting or tapering stipe base and cheilocystidia.

*Entoloma rhodopolium* (Fr.) P. Kumm., Führ. Pilzk. (Zerbst): 98 (1871) – *Agaricus rhodopolius* Fr., Syst. Mycol. 1: 197 (1821)

FINLAND. Pohjois-Karjala. Juuka, Polvela, E of Valkealampi, herb-rich forest dominated by Picea abies, on a slope, near Picea, Populus tremula, Betula, Sorbus aucuparia and Lonicera xylosteum, calcareous soil, 19.IX.2020 Kokkonen 258/20*.

*Entoloma sphagneti* Naveau, Natuurw. Tijdschr. 5: 75 (1923)

FINLAND. Keski-Pohjanmaa. Sievi, Suihkonsalo, an overgrown pit in a ditch by the road, among Sphagnum, 2.IX.2018 Kokkonen 138/18*.

The second record from Finland. Macromorphology similar to the photos in Noordeloos 2004 (the first photo: Finland, Koski Tl., a paludified depression between rocks, 24.IX.1997 M.-L. & P. Heinonen 961-97 F, photo P. Heinonen, J. Vauras pers. comm.) and Brandrud et al. (2018). Pileus 4.5–5.8 cm in diam. Stipe up to 7.9 × 1.1 cm, base dissolved in mosses. Smell and taste farinaceous. Spores 8.6–9.5–11.0 × 6.8–7.3–8.2 μm with Q=1.13–1.32–1.43, heterodiametrical with 6–8 angles. Pileipellis with brown intracellular pigment.

Phylogeny

The ML phylogenetic tree is presented in Figure 10. The clades of the new species were highly supported by the bootstrap and Bayesian BPP values.

Discussion

This paper provides new data about the occurrences
Fig. 10. A maximum likelihood tree of *Rhodopolia* ITS sequences. Part of the sequences originate from Kokkonen (2015). The new sequences and species are highlighted. ML bootstrap values ≥ 50 are given. Branches with Bayesian posterior probabilities ≥ 0.95 have thicker lines. Log likelihood -3690.93.
and distributions of boreal Entoloma, particularly of the species belonging to the subgenus Rhodopolia. Additionally, *E. quercetorum* is described as a new from the hemiboreal zone of Finland and *E. uvidicolola* from the hemiboreal zone of Sweden. *Entoloma flaviale* is described as a new from the northern boreal zone of Finland.

*Entoloma rhodopolium*, which has previously been genetically confirmed only from one site in southern Finland (Kokkonen 2015), occurred as far north as in North Karelia, in the transition zone between southern and middle boreal zones. The soil was calcareous, and *E. rhodopolium* is probably associated there with *Populus tremula* or *Betula*, whereas it usually grows by *Corylus* or *Fagus* in south. It has been reported also near *Betula* from southern Norway (Brandrud et al. 2018).

All observations of *E. boreale*, *E. lupinum*, *E. paragaudatum* and *E. radicipes* were from rich or calcareous forests. *Entoloma boreale* is less demanding than the others, which concentrate on calcareous, often protected herb-rich forests, supporting the importance of these habitats for protection. *Entoloma lupinum* and *E. boreale* sometimes grow near each other, whereas *E. radicipes* seems to prefer different kind of herb-rich forests. It was often accompanied by the rare *Lonicera xylosteum* in eastern Finland. The habitat amplitude of *E. paragaudatum* was rather wide from dry to moist herb-rich forests, but it was not found growing among *Sphagnum*, as usual for the closely related but more common *E. nidorosum*.

The habitats of *E. holmvassdalenense*, *E. sphagneti* and *E. pseudoconferendum* resembled the previously reported habitats abroad (Naveau 1932, Noordeloos 1992, 2004, Brandrud et al. 2019), except that the site of *E. pseudoconferendum* was more nutritious compared with the oligotrophic bogs and ditches in Norway. *Entoloma caeruleopolitum* grew peculiarly in a clearing, but the previously reported sites have also been mainly oligotrophic (Noordeloos 1992, Brandrud et al. 2019).

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**References**

Armada, F. & Lopez, F. 2017: *Entoloma speculum* Fr. (Quél.): espèce controversée. Bull. mycol. bot. Dauphiné-Savoie 226: 5-10.

Brandrud, T.E., Bendiksen, E., Jordal, J.B., Weholt, Ø., Eidissen, S.E., Lorås, J., Dima, B. & Noordeloos, M.E. 2018: *Entoloma* species of the rhodopoloid clade (subgenus *Entoloma*; Tricholomatinae, Basidiomycota) in Norway. Agarica 38: 21-46.

Brandrud, T.E., Bendiksen, E., Jordal, J.B., Weholt, Ø., Dima, B., Morozova, O. & Noordeloos, M.E. 2019: On some *Entoloma* species (Tricholomatinae, Basidiomycota) little known or new to Norway. Agarica 39: 31-52.

Edler, D., Klein, J., Antonelli, A., Silvestro, D. 2019: raxmlGUI 2.0 beta: a graphical interface and toolkit for phylogenetic analyses using RAxML. bioRxiv, doi: https://doi.org/10.1101/800912.

Fries, E.M. 1836: Spicilegium plantarum neglectarum. Decadem primam, Agaricos hyperhodios sistentem / praeside Elia Fries; p.p. Franiscus Theodor. Norœus. Upsaliae.

Fries, E.M. 1838: Epicrisis Systematis Mycologici. Upsaliae.

Fries, E.M. 1867: Icon. Sel. Hymenomycetum nondum delineatorum. Holmiae.

Katoh, S. 2013: MAFFT multiple sequence alignment software version 7: improvements in performance and usability. Molecular Biology and Evolution 30: 772-780.

Kokkonen, K. 2015: A survey of boreal Entoloma with emphasis on the subgenus Rhodopolia. Mycological Progress 14: 116.

Larsson, A. 2014: AliView: a fast and lightweight alignment viewer and editor for large data. Bioinformatics 30: 3276-3278.
Noordeloos, M.E. 1981: *Entoloma* subgenera *Entoloma* and *Allocybe* in the Netherlands and adjacent regions with a reconnaissance of its remaining taxa in Europe. Persoonia 11: 153-256.

Noordeloos, M.E. 1992: Fungi Europaei 5, Entoloma s.l. Candusso, Saronno.

Noordeloos, M.E. 2004: Fungi Europaei 5A, Entoloma s.l., Suppl. Candusso, Alassio.

Richard, F., Roy, M., Shahin, O. et al. 2011: Ectomycorrhizal communities in a Mediterranean forest ecosystem dominated by Quercus ilex: Seasonal dynamics and response to drought in the surface organic horizon. Annals of Forest Science 68: 57-68.

Ronquist, F., Huelsenbeck, J.P. 2003: MrBayes 3: Bayesian phylogenetic inference under mixed models. Bioinformatics 19: 1572-1574.

Stamatakis, A. 2014: RAxML. Version 8: A tool for Phylogenetic Analysis and Post-Analysis of Large Phylogenies. Bioinformatics 30: 1312-1313.

Stöver, B.C. & Müller, K.F. 2010: TreeGraph 2: Combining and visualizing evidence from different phylogenetic analyses. BMC Bioinformatics 11: 7.

Urban, A., Puschenreiter, M., Strauss, J. & Gorfer, M. 2008: Diversity and structure of ectomycorrhizal and co-associated fungal communities in a serpentine soil. Mycorrhiza 18: 339-354.

Electronic Supplementary Material
ESM1.fas. Alignment of ITS sequences.