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. holmvasdalense*, *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. *Rhodopilia* (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 *Rhodopilia* 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 * alongside the descriptions.

For the phylogenetic analysis of *Rhodopilia* 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+Gamma model. The Bayesian analysis was performed with MrBayes 3.2.6 (Ronquist and Huelsenbeck 2003) with GTR + I + G model, 500000 generations, samplefreq 500, printfreq 500 and diagnostfreq 1000. The resulting tree was edited in TreeGraph 2 (Stöver & Müller 2010).

Taxonomy


**SPORES** 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.

<table>
<thead>
<tr>
<th>Species</th>
<th>Specimen</th>
<th>Origin</th>
<th>Accession number</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coeruleopolitum</td>
<td>KK 246/18</td>
<td>Finland</td>
<td>OB998028</td>
</tr>
<tr>
<td>E. fluviale</td>
<td>KK 8/19, holotype</td>
<td>Finland</td>
<td>OB998022</td>
</tr>
<tr>
<td>E. fluviale</td>
<td>KK 10/19</td>
<td>Finland</td>
<td>OB998023</td>
</tr>
<tr>
<td>E. fluviale</td>
<td>KK 1153/12</td>
<td>Finland</td>
<td>OB998024</td>
</tr>
<tr>
<td>E. fluviale</td>
<td>KK 1603/12</td>
<td>Finland</td>
<td>OB998025</td>
</tr>
<tr>
<td>E. fluviale</td>
<td>KK 190/20</td>
<td>Finland</td>
<td>OB998026</td>
</tr>
<tr>
<td>E. fluviale</td>
<td>KK 191/20</td>
<td>Finland</td>
<td>OB998027</td>
</tr>
<tr>
<td>E. holmvasdalense</td>
<td>KK 489/18</td>
<td>Finland</td>
<td>OB998029</td>
</tr>
<tr>
<td>E. nidorosum</td>
<td>S. Ryman 7056, neotype</td>
<td>Sweden</td>
<td>OB998030</td>
</tr>
<tr>
<td>E. nidorosum</td>
<td>J. Ax. Nannfeldt 10526</td>
<td>Sweden</td>
<td>OB998031</td>
</tr>
<tr>
<td>E. nidorosum</td>
<td>J. Ax. Nannfeldt 11356</td>
<td>Sweden</td>
<td>OB998032</td>
</tr>
<tr>
<td>E. pseudoconferendum</td>
<td>KK 137/18</td>
<td>Finland</td>
<td>OB998033</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 117/19, holotype</td>
<td>Finland</td>
<td>OB998034</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 118/19</td>
<td>Finland</td>
<td>OB998035</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 122/19</td>
<td>Finland</td>
<td>OB998036</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 123/19</td>
<td>Finland</td>
<td>OB998037</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 124/19</td>
<td>Finland</td>
<td>OB998040</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 129/19</td>
<td>Finland</td>
<td>OB998039</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 130/19</td>
<td>Finland</td>
<td>OB998042</td>
</tr>
<tr>
<td>E. quercetorum</td>
<td>KK 132/19</td>
<td>Finland</td>
<td>OB998041</td>
</tr>
<tr>
<td>E. rhodopolium</td>
<td>KK 258/20</td>
<td>Finland</td>
<td>OB998043</td>
</tr>
<tr>
<td>E. sericatum</td>
<td>KK 1150/12</td>
<td>Finland</td>
<td>OB998044</td>
</tr>
<tr>
<td>E. sericatum</td>
<td>KK 1152/12</td>
<td>Finland</td>
<td>OB998045</td>
</tr>
<tr>
<td>E. sphagneti</td>
<td>KK 138/18</td>
<td>Finland</td>
<td>OB998046</td>
</tr>
<tr>
<td>E. uvidicola</td>
<td>KK 112/19, holotype</td>
<td>Sweden</td>
<td>OB998047</td>
</tr>
<tr>
<td>E. uvidicola</td>
<td>KK 113/19</td>
<td>Sweden</td>
<td>OB998048</td>
</tr>
</tbody>
</table>
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 uvidicolə Kokkonen, sp. nov.

Synonym Entoloma Kokkonen, sp. nov.

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 hygrophilous 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 (S₃₀⁰ Y₆₀⁰ M₄₀) with a darker centre (S₅₀ Y₅₀ M₅₀), or rather dark brown when old (S₅₀ Y₇₀ M₅₀), at times margin whitish; smooth or slightly radially rugulose when old, slowly 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


Armada & Lopez from France (Arma
data 126). Disagreeing with their identification, the species is described as a new below.

Another species resembling E. nidoroςum, and the closely related E. rhodopolium, was found from a moist mixed forest in Uppsala. It was on average stouter (stipes ≥ 5 mm wide), its lamellae seemed more often decurrent, and the nitrous smell was fainter or absent, when compared with the nidoroςum neotype species. According to Fries (1838), the stipe width of Agaricus nidoroςus was under 5 mm and the lamellae were emarginate, never observed as subdecurrent. However, it is possible that Fries included both species in the protologue. Based on the ITS sequence, the above-mentioned nidoroςum-like species is conspecific with E. speculum var. microsporum Armada & Lopez from France (Arma
da & Lopez 2017). Disagreeing with their identification, the species is described as a new below.

Brandrud et al. (2018) suggested some southern species for E. nidoroςum, probably the same as in Noordeloos (1981, 1992). It was found once in Norway. Its identity remains open, since no genetic data was provided. They regarded it as similar to E. rhodopolium, which indicates a more robust species than the nidoroςum neotype species. Also, the shape of the pileus in their photo differed from the pileus in the plate of Fries (1867).

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 Tartumaa 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 *uvidicola* 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 &

---

**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 roseoalbum* Arnolds & 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 Norrtoran, 8.X.2019 Kokkonen 113/19*, 114/19*.

**Entoloma quercetorum** Kokkonen, sp. nov

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 *Corylus avellana*, *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; applanate, de
erately crowded; at times transvenose; pale grey or
dark grey brown; in stipe pale grey, pale grey brown
or darker grey brown; in stipe pale grey, pale grey brown
or darker grey brown. In stipe pale grey, pale grey brown
or darker grey brown. SMELL spontaneously faintly
aromatic especially when old, indistinct, or "entoloma
colourful" when crushed slightly farinaceous or
indistinct. TASTE indistinct, slightly farinaceous, or
"entoloma colourful".

**SPORES** (6.8)7.4−8.1(11.2)×(4.0)6.4−7.2(10.2)−8.0(8.6)
m, range of mean values 7.9−8.4×7.1−7.5 m, 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 m (n=60), 4-spored. CYSTIDIA not observed.

**PILEIPELLIS** hyphae hyaline or brownish, some
slightly to moderately encrusted; terminal cells cy-
lindrical, fusoid or clavate, usually long, wall thin
or at apex thickish. STIPTIPELLIS: 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 for-
ests 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 se-
quencies, 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 geneti-
cally 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.](image)

*Fig. 6. Entoloma quercetorum*. a holotype. b KK 129/19. c KK 124/19. d KK 123/19.

![Fig. 7. Entoloma quercetorum, microscopic characters.](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.
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 8/19

PILEUS 2.3−5.7 cm in diameter; applanate with recurved when old; pale grey brown to rather dark grey brown, at times with a yellowish hue (ca. Y 6/6−9.5/9), margin paler and umbo usually darker, up to black brown; delicately fibrilllose or smooth, slightly viscid, hygrophanous, translucently striate. LAMELLAE up to 8 mm broad; adnate or emarginate; moderately or rather densely crowded, or rather distant; greyish or pale grey brown when young, then with a pink tinge; edge uneven or even, concolorous. STIPE 2.0−6.7 cm long, 0.3−1.1 cm wide; equal, slightly tapering, or slightly broadening towards base, base roundish or tapering, buried in sand; white, pale grey, or darkening to grey brown downwards; dry, faintly fibrilllose, often shiny, apex at times pruinose.

CONTEXT concolorous with the surface, or dark grey in pileus and pale grey in stipe.

SMELL indistinct or farinaceous when cut.

TASTE indistinct or slightly farinaceous.

SPORES (7.2)7.6−8.5−9.5(9.9) x (6.1)6.6−7.4−8.0(8.5) μm, range of mean values 8.3−8.7 x 7.2−7.6 μm, Q=(1.01)1.06−1.15−1.27(1.29), range of mean Q values 1.12−1.19 (120 spores from six collections); usually subsisodiametrical. BASIDIA 28−38−52 x 10−12−14 μm (n=37), 4- or rarely 2-spored. CHEILOCYSTIDIA absent to abundant, 17−54 x 7−15 μm; flexuous, cylindrical, lageniform, utriform, fusoid, or subglobose; wall thin or at apex thickish, at times apex with scattered small crystals. PILEIPELLIS hyphae brownish or hyaline, rarely with internal pale brown flecks, slightly to strongly encrusted; terminal cells hyphoid, cylindrical, tapering at apex, constricted in the middle, or clavate, wall thin or at apex thickish, at times apex with small crystals or ‘mucus’. STIPTIPPELLIS: terminal cells similar to cheilocystidia.

COMMENTS: Entoloma fluviale is genetically and morphologically close to E. sericatum. The type deviated from the multiple sericatum sequences (Kokkonen 2015) by 9−12 bases and 2 indels. Due to the slight intraspecific genetic variation of both species, the close RPB2 sequences, and the similar morphologies, E. fluviale is distinguishable with difficulty. It may be regarded as a cryptic species. It is characterized by a pileus with a prominent umbo and sometimes having distinct cheilocystidia, but E. sericatum has also sometimes a prominent umbo. Entoloma sericatum has not been observed with cheilocystidia, although it may rarely have scarce, short cystidium-like structures at lamellar edge. Entoloma fluviale seems to be much rarer and has perhaps a restricted habitat in the north. Both species grew together at one site. Within the site, the two species deviated by 7−9 bases from each other. There existed partial intermediate specimens with ambiguous bases in two positions. Overall, the intraspecific variation of E. fluviale was up to 2 bases, the type being the most distant from E. sericatum and the other two specimens of the type site being intraspecific intermediates. The RPB2 sequences of
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:


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 stipitipellis 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 stipitipellis on the left. For symbols, see Figs. 2 and 5.
the river Oulankajoki, 9.IX.2012 Kokkonen 1150/12*, 1152/12*.

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.

SWEDEN. Jämtland. Strömsund, near Torpen, moist herb-rich forest dominated by *Picea abies*, near *Picea, Betula, Oxalis acetosella, Equisetum sylvaticum, Rubus idaeus, Phegopteris connectilis, Dryopteris expansa, Gymnocarpium dryopteris* and *Viola palustris*, further away Entoloma lupinum, 20.VIII.2016 Kokkonen 294/16*. The first record from Sweden.


The first record from Finland. Pileus 1.6−2.0 cm in diam. Lamellae distant, brown. Stipe 4.0−4.1 x 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 subisodiametrical, multi-angled with 7−11 angles. Pileipellis hyphae with abundant brown intracellular pigment.

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


The first record from Finland. Pileus up to 3.9 cm in diam., brown or at margin violaceous grey, entirely blackish squamulose. Lamellae brownish with a concolorous edge. Stipe up to 7.7 x 0.35 cm, brown grey, faintly dark flocculose. Smell faintly aromatic in one collection. Spores 9.2−10.8−12.8 x 7.0−8.0−9.5 μm with a range of mean values 10.5−11.1 x 7.9−8.1 μm, and Q=1.11−1.35−1.53 with a range of mean values 1.32−1.37 (40 spores from 2 collections), heterodiametrical with 6−7 angles. Lamellar edge sterile or heterogeneous. Cheilocystidia hyaline or brownish; fusiform, clavate, cylindrical, utriform, lageniform or mucronate. Basidia 1−4-spored, mostly 2-spored. Pileipellis with brown intracellular pigment.

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


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)


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.


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 fruitbody. 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=1.21–1.32–1.38, heterodiametrical with 7–8 angles. Pileipellis hyphae with brown intracellular pigment, rarely slightly encrusted.

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


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


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

FINLAND. Keski-Pohjanmaa. Sievi, Suikkonsalo, 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. uvidicolae* from the hemiboreal zone of Sweden. *Entoloma fluviale* 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).

### Acknowledgements
The curator Åsa Kruys is thanked for guidance while visiting UPS, and the curator Seppo Huhtinen is thanked for providing facilities in TUR. Some collections were found during the work for Metsähallitus. Kaisa Junninen and Markku Lehtelä are thanked for providing the investigations. An anonymous reviewer is thanked for the comments.

### References


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