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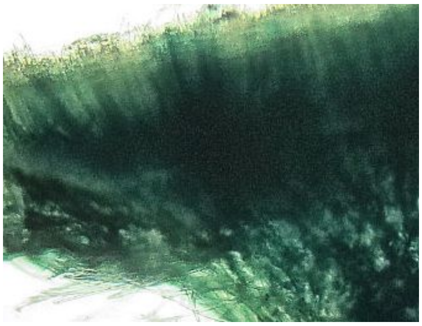

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Forsidebilde: *Cortinarius parasuaveolens*. Foto: Tobias G. Frøslev.

I venstre kolonne denne siden fra toppen:

Paranectria oropensis. Foto: Cristopher Reisborg.

Aeruginoscyphus sericeus. Foto: O. Olsen.

Entoloma majaloides. Foto: O. Morozova.

Råteskader i tømmer. Foto: Mycoteam.

Kjære leser

Vi i Agarica-redaksjonen ønsker først å takke for tålmodigheten og beklager at volum 38 er blitt forsinket. Hovedårsaken er at vi fikk inn mange manus sent.

Redaksjonen har på årsmøtet utvidet fokusområdet til journalen da den tidligere formuleringen potensialt kan ha begrenset antall manus som sendes til Agarica. Nå lyder målteksten som følger: "Tidsskriftet AGARICA publiserer fagfellevurderte originalartikler innen alle ulike aspekter av mykologi."

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Så til denne utgaven av Agarica. Volum 38 inneholder også denne gangen nye arter for Norge: en ny Entoloma-art, 20 arter av ikke-lavdannende bitunikate sekksporesopper og tre sekksporesopper av klassen Sordariomycetes. I tillegg presenteres gruppa omkring lutrødspore (*Rhodopolia*-gruppa) i slekta rødspore (Entoloma) i Norge. En annen artikkel omfatter fem slørsopper fra kalklindeskog med hvitaktig–blekoker hatt ("*C. parvus*-komplekset"; seksjon Calochroi).

I seksjonen for populariserte bidrag har vi denne gangen et sammendrag av et feltkurs i mykologi i Drøbak, samt sammendrag av tre masteroppgaver og en doktorgrad.

Bokomtalen i dette volumet er en vurdering av *Grassland Fungi: A Field Guide* av Wood og Dunkelman. God lesning!

Anders K. Wollan og Gry Alfredsen

NMC i Norge i 2019, i Sunnhordland

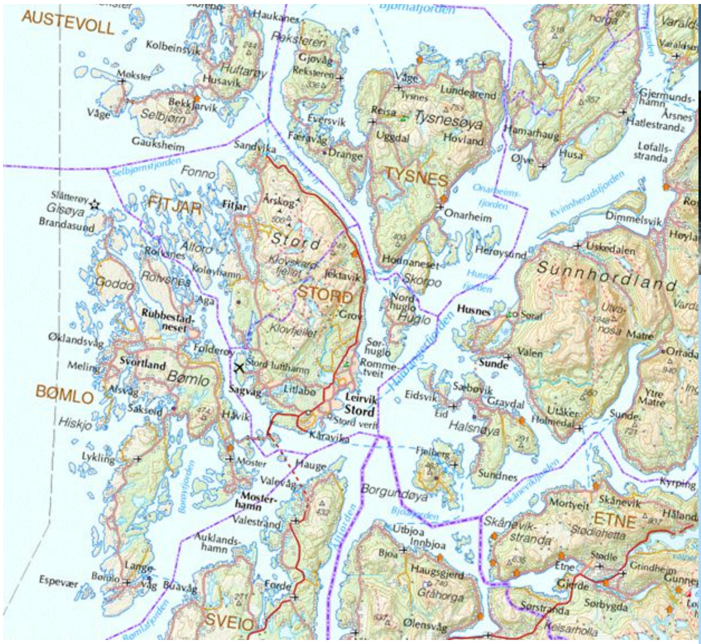
Den 3. til 8. september 2019 arrangerer vi Nordisk mykologisk kongress – NMC XXIV – i Sunnhordland; i øyriket med Stord, Tysnes og Bømlo.

Her er unike kystfuruskoger (boreonemoral regnskog), hotspot-områder for beitemarkssopp på Bømlo, rike, oseaniske eikeskoger med hvit skogfrue, spesielle marmor-skoger med karst, eføy, kristtorn på Storsøy, Søndre Tysnes osv. Vi når de fleste av lokalitetene per bil, men jobber med å få til hensiktsmessig båttransport til noen av kyst- og øylokalitetene.

Praktisk informasjon vil bli lagt ut på www.soppognyttevekster.no den 1. desember. Der vil du også få informasjon om betaling og registrering. En foreløpig påmelding kan eventuelt gjøres til arrangementskomitéen (mail akw), så vil du få beskjed når mer informasjon foreligger.
Arrangementskomitéen har så langt bestått av Katriina og Egil Bendiksen, Tor Erik Brandrud, Klaus Høiland, Håvard Kauserud og Anders K. Wollan (a.k.wollan@nhm.uio.no).

Lokal hjelp har vi fra Per Fadnes. Er du interessert i å bidra til arrangementet så kontakt oss gjerne.

Hilsen arrangementskomitéen



NMC XXIV Sunnhordland; i øyriket med Stord, Tysnes og Bømlo (markert med pil).

Rare, whitish–pale ochre *Cortinarius* species of sect. *Calochroi* from calcareous *Tilia* forests in South East Norway

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Norsk tittel: . Sjeldne, hvite–lysoker slørsopper (*Cortinarius*) av seksjon *Calochroi* fra kalklindeskog i Sørøst-Norge.

Brandrud TE, Frøslev, TG, Dima B, 2018. Notes on some rare, whitish–pale ochre *Cortinarius* species of sect. *Calochroi* from calcareous *Tilia* forests in South East Norway. Agarica 2018 vol. 38, 3–20.

KEYWORDS
Cortinarius, ITS sequences, barcoding gap, morphology, *C. albertii*, *C. catharinae*, *C. parasuaveolens*, *C. subgracilis*, *C. insignibulbus*

NØKKELORD
Cortinarius, ITS-sekvensering, morfologi, *C. albertii*, *C. catharinae*, *C. parasuaveolens*, *C. subgracilis*, *C. insignibulbus*

SAMMENDRAG

Fem slørsopper fra kalklindeskog med hvitaktig–blekoker hatt (“*C. parvus*-komplekset»; seksjon *Calochroi*) er behandlet her. Disse har alle sin verdensnordgrense i Oslofjord–Mjøsa-området, er ekstremt sjeldne og hos oss bundet til kalklindeskogen. De er hver kun kjent fra 1–3, trolig svært gamle, reliktpregete lokaliteter. Selv om disse artene er svært like, og kan være vanskelig å skille, er denne gruppen ikke monofyletisk, og artene opptrer i forskjellige fylogenetiske greiner/klader innenfor *Calochroi*. Basert på makrokjemiske KOH reaksjoner kan to undergrupper skilles ut; de som reagerer kraftig rosa–blodrødt med KOH både på hatt(kant) og undersiden av knollen (*C. albertii, C. catharinae* og *C. parasuaveolens*) og de som reagerer sterkt bare på undersiden av knollen (*C. subgracilis* and *C. insignibulbus*). Den sistnevnte gruppen skilles også på noe større sporer, dog med overlapp til de andre artene. *Cortinarius catharinae* og *C. subgracilis* er bare funnet i vårt sørlige kalklindeskogsområde (Grenland), mens *C. parasuaveolens* og *C. insignibulbus* er funnet i de nordlige områdene (indre Oslofjord–Ringerike–Mjøsa), mens *C. albertii* er registrert både i Grenland og på Ringerike.

ABSTRACT

Five initially whitish-pale ochre *Cortinarius* section *Calochroi* species (“the *C. parvus* complex”) from SE Norwegian calcareous *Tilia* forests are treated. The species have their world’s northernmost localities in the Oslofjord–Mjøsa area, and are all extremely rare; with 1–3 known localities from our *Tilia*

*f*orests, probably very old ones, of relic nature. Although more or less overlapping in morphological features, the group is not monophyletic, and the species belongs to different clades within *Calochroi*. According to their macrochemical KOH-reaction, two subgroups can be distinguished; those with a bright pink-blood red reaction with KOH both on pileus (margin) and bulb underside (*C. albertii, C. catharinae, C. parasuaveolens*) and those with pink-blood red reaction only at bulb underside (*C. subgracilis* and *C. insignibulbus*). The two species of latter subgroup are also distinguished on slightly larger spores. *Cortinarius catharinae* and *C. subgracilis* are recorded only in the southern calcareous *Tilia* forest region (outer Oslofjord), whereas *C. parasuaveolens* and *C. insignibulbus* are found only in the more northern regions (inner Oslofjord-Ringerike-lake Mjøsa), and *C. albertii* is found both in outer Oslofjord and at Ringerike.

INTRODUCTION

Cortinarius is a remarkably large genus of agarics, with more than 2000 species accepted worldwide, including more than 900 species verified with DNA sequences in Garnica et al. (2016). The number of habitat-specific calciphilous species is also remarkable, and e.g. calcareous *Quercus-Carpinus-Fagus-Tilia-Corylus* forests can be extreme hotspots for specialized species of *Cortinarius* assigned to subgenus *Phlegmacium*, in the traditional sense. Many of these species have been cited as strict indicator species for calcareous forest types in Northern (N) Europe (e.g. Brandrud 1999, Brandrud and Bendiksen 2001, Brandrud et al. 2011, Jeppesen and Frøslev 2011) and Central (C) Europe (e.g. Knoch 1990, Gminder 2010, Brandrud and Schmidt-Stohn 2011). According to recent phylogenetic studies, subgen. *Phlegmacium* is not monophyletic (Stensrud et al. 2014, Garnica et al. 2016), and in the following, this group is termed phlegmacioid species.

In Norway, calcareous frondose forests occur as small *Tilia-Corylus*(-*Quercus*) stands on limestone ridges and outcrops (Brandrud 1999, Brandrud et al. 2011, 2016). Calcareous *Tilia cordata* forests are internationally very rare, almost confined to Southeast (SE) Norway (Brandrud 1999, Brandrud et al. 2016). The SE Norwegian calcareous *Tilia* forests are situated outside the natural *Fagus* and *Carpinus* forest range, and where *Quercus* is scarce. It seems that calcareous *Tilia* forests at present are mainly confined to such regions in Europe. These *Tilia* forests of SE Norway are believed to be 6000–7000 years old relics, often with complex, multi-stemmed *Tilia cordata* individuals, which could be as old as their forest stands (Brandrud 1999, Brandrud et al. 2011, 2014, 2016).

A monitoring programme for the habitat-specific calcareous *Tilia* forest fungi was recently initiated, with a base-line monitoring in 2013–2015, including 30 randomly selected localities/sites (Brandrud et al. 2014, 2016). As a result of this monitoring, 89 species of fungi that have their primary habitat in this forest type in Norway are now recognized. More than 60 of these habitat specialists are *Cortinarius* species, including five recently published new taxa (Brandrud et al. 2015, Brandrud et al. 2016, Frøslev et al. 2017). Of the *Cortinarius* species recorded in our calcareous *Tilia* forests, 37 are phlegmacioid taxa, and more than half of these phlegmacioid ones belong to the large monophyletic section *Calochroi* (incl. sect. *Fulvi* sensu Brandrud et al. 1990–2014) (19 taxa; see synoptic tables in Brandrud et al. 2011, 2016).

The majority of the European calochroid species are strictly associated with frondose trees, and could well be said to represent the prototype of calciphilous frondose forest macrofungi. The group is especially speciose in Mediterranean, calcareous *Quercus ilex* forests–woodlands (e.g. Brandrud 2000, Frøslev et al. 2007, Mahiques 2000, Mahiques et al. 2011). In nemoral-temperate regions they are characteristic for calcareous *Fagus* or *Quercus-Carpinus* forests (e.g. Oertel 1984, Jeppesen and Frøslev 2011, Brandrud and Schmidt-Stohn 2011), and in the boreonemoral belt of SE-Norway–SE Sweden they occur in calcareous *Tilia-Corylus* and *Quercus-Corylus* woodlands (Brandrud 1999, Brandrud and Bendiksen 2001). A number of species shows a submediterranean-southern temperate distribution, but many are widely distributed from the Mediterranean Sea to the Oslofjord, having their world's northernmost occurrences in SE Norway. This group also includes a few more strictly *Tilia*-associated taxa, such as *C. osloensis* Brandrud, T.S. Jeppesen & Frøslev, which is only recorded in the SE Norwegian calcareous *Tilia* forests (Frøslev et al. 2006a).

Many of the calochroid species in calcareous *Tilia* forests appear to be extremely rare. Even after long-term studies and intensive monitoring 2013–2015, five species have only been recorded in one out of the 150 presently known calcareous *Tilia* localities/ sites, and seven species only in two (Brandrud et al. 2011, 2016).

The present paper deals with one of the least known and morphologically most difficult groups of species in *Calochroi* in Norwegian calcareous *Tilia* forests. This group of whitish-pale ochre species has earlier been interpreted more broadly as one taxon – i.e. *C. parvus* Rob. Henry (e.g. Moser 1961, Brandrud and Bendiksen 2001) or *C. calochrous* (Pers.) Gray var. *parvus* (Rob. Henry) Brandrud (Brandrud et al. 1990–2014), but is now recognized as a group of morphologically very similar but phylogenetically distinct species. Morphologically, the species are pale with a whitish to very pale yellow ochre pileus or pileus margin when young and unexposed, lilac (to greyish) lamellae, and a bright pink KOH-reaction on the bulb underside (bulbipellis/basal mycelium). Phylogenetically, this morphological complex does not form a supported monophyletic lineage (Frøslev et al. 2007, Garnica et al. 2009, 2016).

The "*C. parvus* complex" illustrates well the fluctuating and conflicting taxonomic approaches and stages in the study of genus *Cortinarius*. Three major approaches can be distinguished during the last 30 years:

(i) *The extreme lumping approach*. In the nordic *Cortinarius Flora Photographica* (Brandrud et al. 1990–2014) the complex was initially treated as *C. calochrous* var. *parvus*, covering all deciduous forest variants with a pale pileus with a whitish margin and whitish universal veil remnants at bulb margin. This lumping was partly based on the continuous nature of morphological characters (such as pileus colours), but also partly a result of lack of information on character variations (due to very little material being available) and an under-emphasis on some taxonomically relevant features such as the KOH-reaction on the bulb underside and pileus (margin).

(ii) *The extreme splitting approach*. The French *Atlas des Cortinaires* (AdC; cf. e.g. Bidaud et al. 2001) has performed an extensive splitting of the presently accepted taxa. For instance, the most frequent taxon in the *C. parvus* group, *C. catharinae*, was in AdC XI (Bidaud et al. 2001) treated as five or six different species (Frøslev et al. 2007), species which according to our morphological and phylogenetic analyses are identical (see further treatment under Taxonomic part).

(iii) *The phylogenetic stages*. With phylogenetic methods our "*C. parvus*" can be separated in at least 5 well-supported phylogenetic species (Frøslev et al. 2007, Garnica et al. 2009, 2016, Bellanger 2015), accompanied by a more or less distinct morphological differentiation. These taxa are further treated and discussed below.

MATERIAL AND METHODS

Norwegian material of the studied, five *Calochroi* species was derived from a monitoring project of 30 sites/localities of calcareous *Tilia* forests in SE Norway 2013–2015, as well as some studies in these *Tilia* forests prior to that. For monitoring results, and data on each site/locality (incl. site GPS-coordinates), see Brandrud et al. (2016). The studied collections are deposited in the herbarium of the University of Oslo, Natural History Museum (O). The descriptions are also based on other European collections made by the authors (for collection lists, see Frøslev et al. 2007, Clericuzio et al. 2017). The colour standard used is that of Cailleux (1981).

Spores and other microscopic features were studied and measured with a 100 × oil immersion lens (achromatic Zeiss and Leiz equipments), with mounts in 2 % KOH. From each basidiocarp, a random selection of ten to twenty mature spores obtained from cortina remnants/stipe surface were measured excluding apiculus and ornamentation. Based on the mean values obtained from these measurement series, the range of spore variation is given in species description (extreme single-spore measurements are thus omitted from the range given). The study of macromorphological features are based on notes on fresh material. For macrochemical reactions 10-40% KOH was applied.

The nrDNA ITS region was sequenced in all studied collections. DNA extraction, PCR and sequencing procedures followed Brandrud et al. (2015). The ITS sequences of the 5 species treated here were supplemented with sequences of morphological similar species mentioned in the Taxonomy part. Alignment was done by MAFFT online version 7 (http://mafft.cbrc.jp/alignment/server/) using the E-INS-I method (Katoh and Standley 2013). After manual adjustment in SeaView (Gouy et al. 2010), Maximum Likelihood analysis was performed in PhyML online (Guindon et al. 2010) using the GTR+I+Γ model of evolution. The resulting phylogenetic tree was edited in MEGA 7 (Kumar et al., 2016) and shown in Figure1.

RESULTS AND DISCUSSION

All five of the now accepted calochroid species in the "*C. parvus* complex" in Europe (Figure 1) were recorded and verified with ITS sequences in our calcareous *Tilia* forests during our recent extensive surveying and monitoring studies. The species were among the rarest taxa in our monitoring data, recorded at only one locality/site (*C. parasuaveolens, C. subgracilis*), two localities (*C. albertii, C. catharinae*) or three localities (*C. insignibulbus*). Apart from one area where *C. albertii* and *C. parasuaveolens* occur close to each other, the species are not co-occurring on the same localities. *Cortinarius catharinae* and *C. subgracilis* differ from the others by occurrence only in the southern calcareous *Tilia* forest region (outer Oslofjord). Due to sparse material, some collections would have been impossible to identify with certainty without sequencing.

The sequencing of our material confirmed the results of Frøslev et al. (2007) and Garnica et al. (2009, 2016), that the five pale species of the "*C. parvus* complex" are phylogenetically well-separated and the individual clusters are well-supported and monophyletic units, with a clear and constant barcoding gap towards neighbouring clusters/taxa (Figure 1), and with little intraspecific genetic variation. The "*C. parvus* complex" did not, however, form a monophyletic group, but occurred intermixed with some species with lilac tinged pileus, and some with more yellow tinged

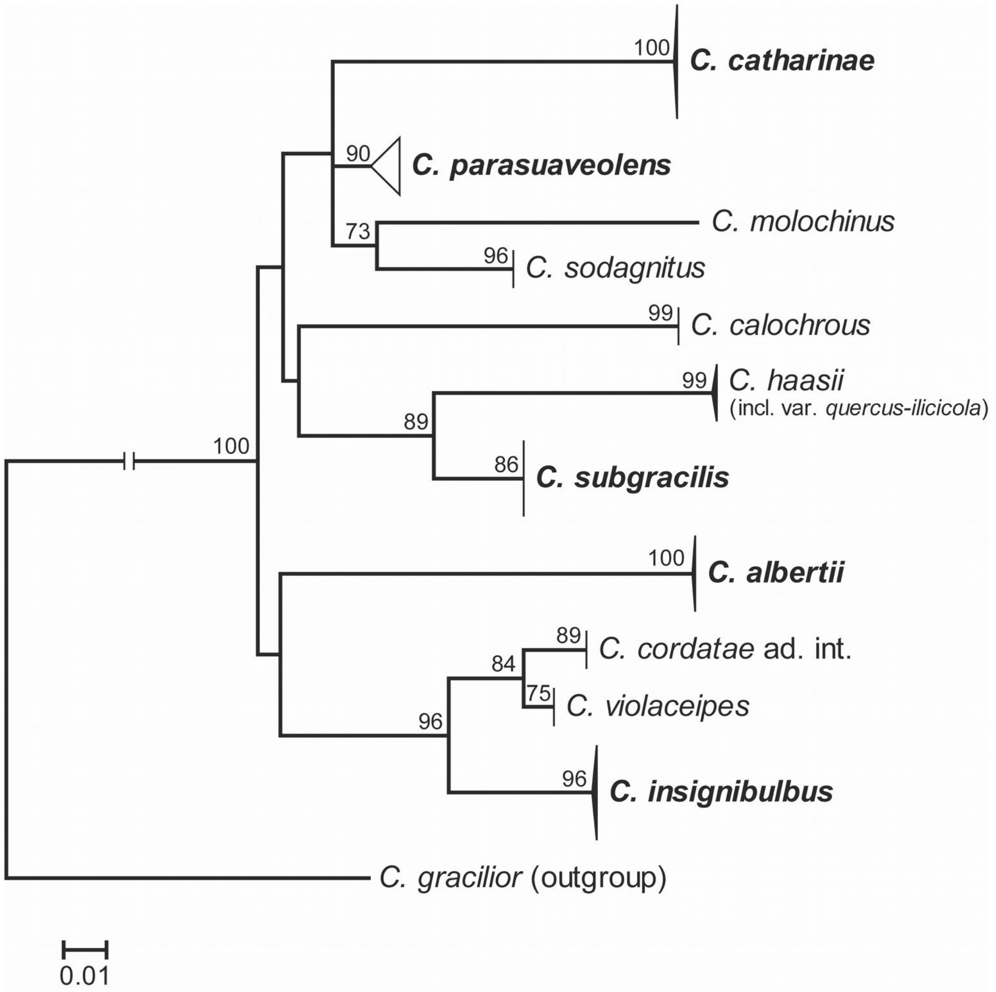

Figure 1. PhyML phylogenetic tree inferred from nrDNA ITS sequences of the studied *Calochroi* species shown as compressed, terminal monophyletic clades. *Cortinarius gracilior* was used for outgroup. Bootstrap support values > 70% are indicated at branches. Scale bar indicates 0.01 expected change per site per branch.

pileus (margin) when young. Only two of our species come close in our phylogenetic tree, namely *C. catharinae* and *C. parasuaveolens* (Figure 1), but with an unresolved relationship presented as a soft polytomy. With other tree clustering methods applied, the two species fell more distantly from each other (data not shown, but see phylogenetic tree in Clericuzio et al. 2017). Their ITS dissimilarity is rather considerable. *Cortinarius parasuaveolens* differs from *C. catharinae* by >20 basepairs, and from the more bluish tinged *C. molochinus* by >25 basepairs. Whereas *C. albertii* occupies a fairly isolated position in our tree, *C. subgracilis* is a well-supported sister to the *C. haasii*-group (with yellow pileus and basal-mycelium), and *C. insignibulbus* a well-supported sister to the *C. violaceipes*-*C.*

cordatae group (with lilac-violaceous spotted pileus).

Re-examination of our material combined with studies of the descriptions in literature revealed that all five species have differences in morphology, although seemingly with some character overlap. The morphological differentiation is treated in detail in taxonomic part.

Cortinarius albertii Dima, Frøslev & T.S. Jeppesen
Fig. 2.

Misapplied name: *Cortinarius calochrous* (Pers.) Gray var. *parvus* (Rob. Henry) Brandrud sensu Brandrud et al. (1992); Cortin. Fl. Photogr. 2: B53 p.p.

Illustration: Frøslev et al. (2006), Mycol. Res. 110: 1048.

Pileus 4–8(–10) cm, viscid–glutinous, glabrous; initially usually pure whitish, at least towards margin, but often entire pileus white when covered by leaf litter, soon with ochraceous brown spots or stripes from centre (N–P 65) due to oxidation, often rendering the pileus bicoloured, marginal zone persistently whitish (where not bruised). Universal veil remnants sparse, sometimes as whitish, soon (dark) brownish patches at centre.

Lamellae initially pale greyish or rarely faintly lilac tinged, lilac tinges especially (or only) towards edge, finally more greyish brown.

Stipe 4–9(–10) × (0.8–)1–1.5 cm; at base with a strongly marginated, broad and flattened bulb up to 4 cm; stipe colour greyish white, often becoming somewhat brownish (spotted) with age. Universal veil at bulb margin initially rather thick, sometimes almost volva-like, but soon more diffuse, whitish, later often turning brownish.

Context white, with (ochre) greyish hygrophanous streaks in stipe apex. *Smell* faint to distinct dust/earth-like, especially the lamellae.

Macrochemical reaction: KOH (10–40%) bright pink on pileus (margin) when young,

Figure 2. *Cortinarius albertii*. One of two verified occurrences in Norway (TEB 224-10, Blekebakken NR, Telemark, outer Oslofjord). Photo: Kristin H. Brandrud.

then blood red, on base of bulb (basal mycelium/bulbipellis) bright pink (–pinkish red).

Spores 9.5–11 × 5.5–6.5(–7) µm, MV = 10.1 × 6.2 µm, amygdaloid, sometimes slightly citriform, strongly and coarsely (crust-like/net-like) verrucose. *Pileipellis* thick, simplex, of narrow hyphae, some filled with yellow pigment lumps (necropigment). Pale hyphae become distinctly pink with KOH, yellow hyphae more diffuse vinaceous.

Habitat: In calcareous *Tilia* forests, with *Tilia cordata* and *Corylus avellana*, on small limestone shelves or among stones in steep scree areas with substantial accumulation of leaf litter/humus (SE Norway; e.g. Brandrud et al. 2018). In S Scandinavia–C Europe mainly in calcareous *Fagus* forest, in the Mediterranean areas mainly in calcareous *Quercus ilex* forests, usually in organic soils (leaf litter).

Localites in SE Norway (*Tilia*): Telemark, Porsgrunn, Blekebakken NR, T.E. Brandrud, TEB 224-10. Buskerud, Hole, Sønsterudelva east (Ringerike), T.E. Brandrud & B. Dima, TEB 293a,b-17.

Distribution: Widely distributed in Europe, but apparently everywhere rare and restricted to calcareous frondose forest hotspots. Exact distribution is, however, little known due to confusion with similar species (especially the more common *C. catharinae*). Probably with a mainly southern distribution, with a number of verified records from Mediterranean E Spain–S France regions (Frøslev et al. 2006b). Also verified from nemoral–colline areas of Hungary, Germany and north to Denmark–S Sweden, with the here listed boreonemoral outposts in the Oslofjord-Ringerike area of SE Norway (Brandrud et al. 2018).

Comments: When well-developed, *C. albertii* should normally be possible to distinguish from the other species in the "*C. parvus* complex" by the initially non-yellow, often pure white pileus (margin) and pale greyish lamellae, without or with only sparse lilac–bluish tinges. The KOH-reaction is very strong and immediate: bright pink-red on pileus (margin) and bulbipellis/basal mycelium. *Cortinarius catharinae* has a very similar KOH-reaction, but more blood red than pink on pileus, and on average not so intense. *Cortinarius catharinae* may also initially be very pale on pileus margin, but soon develops a faint yellow ochre tinge, and the lamellae are distinct to bright lilac(–pink). The spores are almost identical. *Cortinarius parasuaveolens* also possesses a strong red/pink KOH-reaction, but has slightly larger spores (10–11.5 × 5.5–6.5 µm versus 9.5–11 × 5.5–6.5 µm). Moreover, the basidiocarps of the latter are hardly pure whitish, and may also have some lilac tinges on bulb margin and/or pileus margin when (very) young. All these three species seem to have more or less the same habitat requirements, and may even be co-occurring in the same sites. *Cortinarius albertii* seems more restricted to soils with a (deep) leaf-litter layer than the others, and substrate remnants attached to base of bulb is always organic soil/litter. The two remaining taxa, *C. insignibulbus* and *C. subgracilis*, show no, or a weak KOH-reaction on pileus margin.

The species is so far recorded and ITS-verified only from two localities in our calcareous *Tilia* forests. One of these was found in 2017 in a large, newly discovered scree *Tilia* forest near the Tyrifjord at the Ringerike region (Sønsterudelva E; Brandrud et al. 2018). The material depicted in Brandrud and Bendiksen (2001, as *C. parvus*) were from an adjacent scree forest at Ringerike, and probably also represent *C. albertii*, although the lamellae appear too much lilac in the picture. This has yet to be verified by sequencing.

Cortinarius catharinae Consiglio
Fig. 3.

Syn: *Cortinarius albolutescens* Reumaux; *C. pallens* Eyssart. & Reumaux; *C. pseudoparvus* Bidaud.

Misapplied names: *Cortinarius calochrous* (Pers.) Gray var. *parvus* (Rob. Henry) Brandrud sensu Brandrud et al. (1992); Cortin. Fl. Photogr. 2: B53 p.p. *Cortinarius xanthochrous* P.D. Orton sensu Bidaud et al. (2001).

Illustrations: Consiglio et al. (2003), Gen. Cortin. Ital. 1 A19 (upper; holot.). Brandrud et al. (1992), Cortin. Fl. Photogr. 2: B53. Bidaud et al. (2001), Atl. Cortin. 11: 334 (as *C. pallens*), 335 (lower, as *C. pseudoparvus)*, 337 (as *C. albolutescens*)

Pileus 3–8(–10) cm, viscid–glutinous, glabrous; colour variable, initially usually whitish, at least towards margin, then becoming more ochraceous brown from centre (N60–65, P 60–65), and then tinged ochraceous yellow towards margin (K85(–K87)); rarely more (ochraceous) yellow already when young.

Lamellae intensely (to pale) lilac blue, edge sometimes persistently lilac, finally more greyish brown.

Stipe 4–6 × 0.8–1.5 cm; at base with a marginate, broad and flattened bulb up to 4 cm; stipe colour greyish white, sometimes with a faint lilac tinge at apex.

Context (greyish) white. *Smell* faint to distinct dust/earth-like, especially the lamellae.

Macrochemical reaction: KOH (10–40%) strongly blood red on pileus (margin), bright pink (-pinkish red) on base of bulb (bulbipellis/basal mycelium).

Spores 9.5–10.5(–11) × 5.5–6(–6.5) µm, MV = 10.1 × 5.9 µm, amygdaloid to somewhat ellipsoid, sometimes slightly citriform, strongly and coarsely (crust-like/net-like) verrucose.

Pileipellis thick, simplex, of narrow hyphae, many become gradually filled with bright yellow pigment lumps. Pale hyphae (without yellow pigment lumps) become distinctly pink with KOH.

Figure 3. *Cortinarius catharinae*. The most frequent of the pale *Calochroi* in C/S Europe, but only two verified finds in Norway so far (TEB 546-14/DB5518, Åsstranda NR, Telemark, outer Oslofjord). Photo: Bálint Dima.

Habitat: In calcareous *Tilia* forests, with *Tilia cordata* and *Corylus avellana*, on small limestone benches/shelves with some accumulation of leaf litter (SE Norway). In S Scandinavia–C Europe mainly in calcareous *Fagus* and *Quercus-Carpinus* forests, as well as thermophilous *Quercus cerris-Q. pubescens* forests, in the Mediterranean areas mainly in *Quercus ilex* forests, usually in organic soils (leaf litter).

Localities in SE Norway (*Tilia*): Telemark, Porsgrunn, Åsstranda NR, T.E. Brandrud & B. Dima, TEB 546-14 / DB5518 (O). Skien, Slettevann N, T.E. Brandrud & S. Reiso, TEB 624-14 (O).

Distribution: Cortinarius catharinae is widely distributed in Europe, from Mediterranean areas of Spain, S France and Italy, to the northern outposts in SE Norway. The species is one of the more frequent taxa in the *C. calochrous* complex in calcareous *Fagus* and *Quercus* forests of C Europe.

Comments: Among the five pale *Calochroi* species, *C. catharinae* is – together with *C. albertii* and *C. parasuaveolens* – distinguished by the strong, positive KOH-reaction on all surfaces; becoming instantly blood red/pink on pileus (margin) and bright pink on the bulb underside (basal mycelium/bulbipellis). *Cortinarius catharinae* is distinguished from *C. albertii* mainly by the faint ochraceous yellow tinge that develops rapidly when the pileus expands, the bright and often persistent lilac colours on the lamellae, and the slightly different KOH-reaction on pileipellis (blood red vs. strong pink). *Cortinarius parasuaveolens* may be quite similar to *C. catharinae*, but can often be distinguished on some faint lilac tinges on stipe, bulb margin or pileus margin, and then with a more skin coloured tinge on the pileus centre. *C. insignibulbus* is also whitish when young, but is distinguished by the negative KOH-reaction on the pileus (but still pink on the bulb underside), whereas the last taxon – *C. subgracilis* – usually shows an ‘intermediate’ faint pinkish grey KOH-reaction on the pileus (margin).

Among *Calochroi* species not treated here, *C. catharinae* could in the calcareous *Tilia* forests chiefly be mixed with *C. sublilacinopes*. However, the latter possess a more distinctly ochraceous yellow pileus margin, and has a negative reaction with KOH. Furthermore, these are apparently occurring in different regions; *C. sublilacinopes* is only found in in inner Oslofjord-Ringerike. *Cortinarius catharinae* is so far verified only from two localities in outer Oslofjord (Åsstranda, Porsgrunn, Slettevann, Skien). However, also three old collections from Blekebakken nature reserve, Porsgrunn, probably belong here (TEB 99-92, 43-93, 55-94; cf. Brandrud and Bendiksen 2001, as *C. parvus*), but we have not been able to verify this by sequences.

In general, *C. catharinae* seems to be the most common taxon of the ‘*C. parvus* complex’ in Europe, and it is one of the most frequently recorded *Calochroi* species in calcareous *Quercus-Fagus* forests (pers. obs.; see also Bidaud et al. 2001 as *C. albolutescens*, *C. cremeus*, *C. pallens*, *C. pseudoparvus*, *C. xanthochrous*, Consiglio et al 2003–2007, Frøslev et al. 2007, Clericuzio et al. 2017). The “classical name” *C. parvus* Rob. Henry (Henry 1935) has often been used for this species. However, this name is apparently not applicable, as the KOH reaction is indicated as negative, a feature also confirmed by Henry in later publications (Henry 1990). A “heterotype” designated by Henry was found in the Henry herbarium in herb. PC, but was contaminated and did not yield any relevant sequence.

Cortinarius parasuaveolens (Bon & Trescol) Bidaud, Moënne-Locc. & Reumaux
Fig. 4.

Basionym: Cortinarius sodagnitus var. *parasuaveolens* Bon & Trescol (1988), *Docum. Mycol*. 19(73): 36.

Syn.: *Cortinarius pseudogracilior* Reumaux in Bidaud et al. (2006) Atlas des Cortinaires 16: 1099.

Illustrations: Clericuzio et al. (2017), Sydowia 69: 221–222.

Pileus 4–7 cm, viscid–glutinous, glabrous, some with white, appressed veil remnants at centre; initially usually whitish to greyish white (–ochraceous white) towards margin, with an ochraceous (grey)brown tinge towards centre (N65), later somewhat more ochraceous brown spotted, sometimes initially with a faint lilac tinge towards margin (from veil?) and then with a more skin-coloured-incarnate tinge towards centre (K70–71).

Lamellae initially pale greyish lilac(–pink), lilac tinge mainly in the lamellae edge, discolouring to greyish brown with pale edge.

Stipe 4–6(–8) × 0.7–1.5 cm; bulb marginated, broad and flattened or not, up to 3 cm broad, veil remnants on bulb margin abundant or not, initially whitish to pale lilac; stipe initially greyish or with a lilac blue tinge, also lilac spots on the bulb margin, soon greyish white.

Context (greyish) white, initially lilac in cortex of stipe and bulb. *Smell* indistinct.

Macrochemical reaction: KOH (10–40 %) blood red to vinaceous grey on pileus margin, on the bulb underside bright pink, on bulb margin pinkish red.

Spores 10–11(–11.5) × 5.5–6.5 µm, MV = 10.5 × 6.0 µm, amygdaloid(-ellipsoid), moderately strongly to strongly and coarsely ver-

Figure 4. *Cortinarius parasuaveolens*. Here depicted from *Quercus-Corylus* forest at Öland, Sweden (TF 2013-111) Photo: Tobias G. Frøslev.

rucose. *Pileipellis* thick, simplex, of narrow hyphae, entangled-erect at surface, a number with yellowish pigment, hyphae (especially the non-yellow pigmented) become pink when KOH is added.

Habitat: In calcareous *Tilia* forest with *Tilia cordata*, in stony, steep scree slope with gravel and accumulation of leaf litter between the stones (SE Norway). Otherwise recorded mainly in southern, thermophilous oak forests with *Quercus pubescens*, *Q. cerris* or *Q. ilex*, as well as *Carpinus betulus* forests and northern outposts in *Quercus robur-Corylus avellana* woodland (Öland, SE Sweden).

Locality in SE Norway (Tilia): Buskerud, Hole, Bråtafjellet (near the Tyrifjord, Ringerike NW of Oslo), T.E. Brandrud, TEB 724-11.

Distribution: Apparently widespread in Europe, but very little known, due to confusion with *C. catharinae* and other species. Up to quite recently only published from France, but according to new, sequenced records presented in Clericuzio et al. (2017) it is now also known from E and W Italy, Hungary and SE Sweden. Most records are from southern mediterranean-submediterranean regions, with only few outposts in the boreonemoral Northern Europe region (se distributional map in Claricuzio et al. 2017).

Comments: In SE Norway, *Cortinarius parasuaveolens* is only known from one small, unripe basidiocarp from Bråtafjellet near the Tyrifjord, which was verified with ITS sequencing. The species has been very little known up to now, and new data on the taxonomy and nomenclature is presented in Clericuzio et al. (2017). The above description is based mainly on data from this publication. The species is very similar to *C. catharinae*, with a pale pileus and bright pink–lilac lamellae, and they may co-occur. However, a (very) faint greyish-lilac tinge in young pilei sometimes gives C. *parasuaveolens* a skin-coloured tinge that is not seen in *C. catharinae*, but gives a superficial resemblance to e.g. *C. molochinus* Bidaud & Ramm, which is also phylogenetically rather close (Figure 1). Furthermore, *C. parasuaveolens* is sometimes distinctly lilac on the stipe and/or bulb margin. More material is, however, needed to evaluate the variation and significance of theses lilac tinges for species delimitations. The spores of *C. parasuaveolens* are on average slightly larger than those of *C. catharinae* (mean value 10.5 × 6.0 µm versus 10.1 ×5.9 µm), but still not enough to separate these. The shape of the spores is quite similar. With present knowledge, the two species should be regarded as semi-cryptic, and sequencing is needed for critical identifications.

The species was first described as *C. sodagnitus* var. *parasuaveolens* by Bon and Trescol (1988) from France. They described a *C. suaveolens* look-a-like with pronounced lilac colours on the pileus margin, and yet the ITS sequence of the type matches the present taxon (Bellanger et al. 2017, Clericuzio et al. 2017). The lilac colours emphasized in the protologue either indicates that our species may have pronounced lilac colours at pileus margin, or that Bon and Trescol (1988) included another element in their description of the species.

Liimatainen et al. (2014) found that the type of *C. pseudogracilior* also conforms with our species, based in ITS sequencing. In the protologue (Bidaud et al. 2006), *C. pseudogracilior* was described as a slender, pale species, almost without any bluish–lilac tinges, and it was compared with the small *C. gracilior* and placed in sect. *Multiformes* s. lat. (and not in sect. *Calochroi*). This does not fit very well with our species. However, the micro characters (investigated later by Bidaud; Bidaud et al. 2006) correspond much better (including a pink KOH reaction of pileipellis hyphae), and it is possible that there has been a mix of collections, and that the macro description is based on something else (Clericuzio et al. 2017).

Cortinarius subgracilis Moënne-Locc. Fig. 5.

Misapplied name: ?*Cortinarius subarquatus* (M.M. Moser) M.M. Moser, in Moser (1952) Sydowia 6(1–4): 59.

Illustration: Bidaud et al (2001), Atl. Cortin. 11: 330

Cap 4–6 cm, viscid–glutinous, glabrous, sometimes with diffuse whitish (later brownish) patches of veil remnants at centre; initially ochraceous white with whitish–greyish white margin (K91–92), centre becoming more ochraceous brown (N65), with age often distinctly bicoloured (brown centre, pale margin; entire pileus might be whitish if covered by leaves).

Lamellae pale greyish lilac, lilac tinges mainly towards the edge, rather fugacious.

Stipe 4–5 cm × 0.8–1.2 cm; at base with a marginate, broad and flattened bulb up to 2.5 cm; bulb margin often with distinct, volva-like, whitish veil remnants; stipe colour white to ochraceous white.

Context (greyish) white.

Smell weak to distinct earth/dust-like.

Macrochemical reaction: KOH (10–40 %) pale/indistinct pinkish–vinaceous grey to more red brown on pileus margin, bulb underside (basal mycelium) deep pink to pinkish red, distinct reddish tinge also on veil remnants at bulb margin.

Spores 10–11.5 × 6–7 µm, MV = 10.7 × 6.5 µm, amygdaloid to faintly citriform, strongly and coarsely (crust-like/net-like) verrucose.

Pileipellis thick, simplex of narrow hyphae, some filled with yellow brown content.

Habitat: In calcareous *Tilia* forest with *Tilia cordata* and *Quercus robur*, on small limestone shelfs with some leaf litter (SE Norway). In C Europe the species occur in strongly calcareous *Abies alba* (mixed) forests, in Sweden (Gotland) in calcareous *Pinus* forests. In S Europe in calcareous *Quercus ilex* forests.

Figure 5. *Cortinarius subgracilis*. One verified occurrence in Norway (TEB 298-10, Kongkleivåsen N, Telemark, outer Oslofjord). Photo Kristin H. Brandrud.

Locality in SE Norway (Tilia): Telemark, Porsgrunn, Kongkleivåsen N (Hitterødbekken S; N of Frierflogene nature reserve), T.E. Brandrud, TEB 297-10.

Distribution: *Cortinarius subgracilis* is known from one locality in Norway; along the limestone plateau edge of Frierflogene-Kongkleivåsen in Porsgrunn, Grenland. Elsewhere in Europe, the species has a core area in the most calcareous, montane *Abies alba* forests (or mixed forests with *Abies*) in the Prealps in Austria-Switzerland and the French Jura north to Black forest. Recently found also in *Abies nordmanniana* dominated forests in W Caucasus (Brandrud et al., in prep.). Then the species re-appear in the far south, in the Mediterranean parts of Spain and France in evergreen oak forests.

Comments: *Cortinarius subgracilis* is a pale species with a broad, flattened bulb, and comparatively large spores. The species' often bicoloured appearance (pileus with ochre brown centre and whitish margin) is typical, although somewhat dependent on age and weather conditions. The species is according to own finds locally rather frequent in calcareous *Abies*-dominated forests in C Europe. However, it has been remarkably overlooked, probably due to confusion with a series of similar (although more yellow or lilac-tinged) *Calochroi* species in this kind of habitat (Brandrud et al., in prep.). In frondose forests, *Cortinarius subgracilis* can be distinguished from the other pale taxa by the KOH-reaction on the pileus: *C. albertii*, *C. catharinae* and *C. parasuaveolens* have a stronger pinkish red reaction, and *C. insignibulbus* has a negative KOH reaction. Furthermore, the spores of *C. subgracilis* are somewhat larger than those of *C. albertii* and *C. catharinae* (10–11.5 × 6–7 µm, versus 9.5–11 × 5.5–6.5 µm).

(iv) The species is in SE Norway found in only one locality, along the Frierflaugene limestone plateau edge. Here it was in 2010 collected from three different spots (TEB 252-10, 297-10, TEB 298-10), but only one of them verified by sequencing. This Norwegian locality is the only known occurrence of *C. subgracilis* north of the Alps in thermophilous deciduous forests (with *Quercus*, *Tilia*). This kind of habitat for the species is otherwise only known from the Mediterranean areas. The description above is based solely on our Norwegian material from *Tilia-Quercus* forests (cfr. Figure 5), but this seems to be morphologically quite similar to the variant in *Abies*(-*Pinus-Picea*) forests. The southern *Quercus ilex* populations seem to differ by the presence of lilac tinges (sub nom. *C. malvaceopileatus* Bidaud & Raffini; J.-M. Bellanger pers. comm.), and thus it is possible that these may be morphologically distinguishable from other variants. Some of the Mediterranean collections apparently differ by one nucleotide from typical *C. subgracilis*, but other collections appear identical to the type (unpublished data), and this differentiation needs more study. It is possible that this differentiation reflect the eco-geographical variation. A small genetic differentiation is also seen in related taxa, such as *C. haasii* (M.M. Moser) M.M. Moser, with the main populations in *Abies* forests, and with southern frondose forest populations (*C. haasii* var. *quercus-ilicicola* A. Ortega, Suár.-Sant. & J.D. Reyes = *C. aurantiorufus* Bidaud), differing in spore-morphology and a couple of differences also in ITS sequences (Schmidt-Stohn et al. 2016).

According to data available so far, the Norwegian *Tilia-Quercus* forest population seems to be more similar to the *Abies* forest populations in C Europe than to the southern *Quercus* populations, but this needs further study. Our Oslofjord population should anyhow be regarded as a remarkable isolated, ecologically deviating outpost – probably of relic nature.

Cortinarius insignibulbus Bidaud & Moënne-Locc.
Fig. 6.

Syn: *Cortinarius calochrous* (Pers.) Gray f. *violascens* Rob. Henry ex. Bidaud, Moënne-Locc. & Reumaux

Misapplied names: *Cortinarius calochrous* (Pers.) Gray var. *parvus* (Rob. Henry) Brandrud sensu Brandrud et al. 1992 Cortin. Fl. Photogr. 2: B53 p.p. *C. subamethystinus* Rob. Henry sensu Bidaud et al. 2001 Atl. Cortin 11.

Illustrations: Bidaud et al (2001), et al. Cortin. 11: 342, 341 (as *C. subamethystinus*), 330 (as *C. calochrous* f. *violascens*)

Pileus 4–10 cm, viscid–glutinous, glabrous to somewhat tomentose when dry, incurved margin young with drop-like spots; initially greyish white to beige white («pearl white»; K92), pale colour usually rather persistent, but can discolour somewhat ochraceous brown (K90–91, M69–65) from centre with age, sometimes with a faint lilac tinge towards margin, and then with more skin-coloured-pinkish brown tinges in the centre.

Lamellae rather persistent pale to bright lilac blue, lilac colour sometimes more pronounced towards edge.

Stipe 5–7 × 1–1.5 cm; at base with a marginated, broad and flattened bulb up to 3.5 cm; stipe colour pale to strong and persistent lilac, especially at apex, sometimes with a lilac tinge also at bulb margin and on basal mycelium when (very) young.

Context (greyish) white, lilac in stipe cortex, sometimes also in the margin of bulb (when very young).

Smell faint to distinctly earth/dust-like.

Macrochemical reaction: KOH (10–40 %) negative (greyish brown, rarely faintly pinkish brown at white margin)) on pileus, on the underside of bulb (basal mycelium) bright pink, a faint pinkish tinge also on the bulb margin when young.

Spores 10–12 × 6–7 µm, MV = 11.2 × 6.5 µm, amygdaloid to faintly citriform, strongly and coarsely (crust/net-like) verrucose.

Pileipellis thick, simplex, of narrow hyphae, with age some filled with strongly yellow pigment lumps, no pink colour tinge when KOH is added.

Habitat: In calcareous *Tilia* forest with *Tilia cordata*, in scree areas with limestone gravel and some leaf litter (SE Norway). Elsewhere mainly in calcareous *Fagus* forests, in France also in *Carpinus* forests.

Localities in SE Norway (*Tilia*): Oppland, Gjøvik, Biri, Eriksrud NR, T.E. Brandrud & B. Dima, TEB 256-14 (O) / DB5370 (BP), TEB 362b-14 (O) / DB5428 (BP). Akershus, Asker, Ormodden, T.E. Brandrud & B. Dima, TEB 398-14 (O). Buskerud, Røyken, Lillelien W, T.E. Brandrud & B. Dima, TEB 326-17 (O).

Distribution: *Cortinarius insignibulbus* is known from three localities in SE Norway (one along Lake Mjøsa and two in inner Oslofjord). Apart from these records, the species has in N Europe only been recorded from a couple of sites in Denmark (Frøslev et al. 2007). The species appears to be very rare everywhere, with confirmed records outside Scandinavia only from nemoral (temperate) France, Germany, Italy (Bidaud et al. 2001, Frøslev et al. 2007), and Hungary (unpublished).

Comments: *Cortinarius insignibulbus* is little known and rarely treated in literature (but see Bidaud et al. 2001, Frøslev et al. 2007). In *Atlas des Cortinaires* (Bidaud et al. 2001) the species is described threefold, under the names *C. insignibulbus*, *C. subamethystinus* sensu Bidaud et al. and *C. calochrous* f. *violascens*. The conspecificity of all three taxa was confirmed by ITS sequencing (Frøslev 2007 et al.). The species is clearly distinguished from the other pale *Calochroi* species by the KOH reaction, which is strikingly different on bulb underside (bright pink) versus pileus surface (negative) (Fig. 6b), a feature not mentioned in the descriptions in Bidaud et al.

Figure 6a,b. *Cortinarius insignibulbus*. From one of the three localities in Norway (TEB 256-14 & 362b-14/DB5370 & DB5428, Eriksrud NR, Biri, Oppland, lake Mjøsa W). See the difference in KOH reaction on bulb and pileus margin in fig. 6b. Photo: Bálint Dima.

(2001). The rather persistently pale, pearl white pileus contrasting the beautiful lilac lamellae and stipe apex is also a characteristic feature. Sometimes the entire stipe is deep and persistently lilac-purplish (see Bidaud et al 2001 as *C. subamethystinus*). Furthermore, the species also has slightly larger spores than those of *C. albertii*, *C. catharinae* and *C. parasuaveolens*, but hardly different from those of *C. subgracilis*. In contrast to the other taxa treated here, *C. insignibulbus* seems to be lacking from Mediterranean *Quercus ilex* forests.

Phylogenetic analyses (based on ITS sequence data) indicate that *C. insignibulbus* is most closely related to species with lilac pileus colours, such as *C. violaceipes* and *C. molochinus*. With age these species can lose their lilac tinges, and may then be difficult to distinguish from *C. insignibulbus*. This applies especially to pale variants of *C. violaceipes*, which also have the same KOH reaction. *Cortinarius violaceipes* is recently confirmed from SE Norwegian *Tilia* forests, but from another region than *C. insignibulbus* (outermost Oslofjord).

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Entoloma species of the rhodopolioid clade (subgenus *Entoloma*; Tricholomatinae, Basidiomycota) in Norway

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Norsk tittel: Rødsporer i *Rhodopolia*-gruppa (*Entoloma* underslekt *Entoloma*; Tricholomatinae, Basidiomycota) i Norge

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NØKKELORD: DNA-sekvensering, økologi, utbredelse, *Salix-Alnus-Betula*-arter, *Tilia-Quercus*-arter

SAMMENDRAG

Gruppa omkring lutrødspore (*Rhodopolia*-gruppa) i slekta rødspore (*Entoloma*) i Norge presenteres. Gruppa består av musserongaktige og flathattaktige, sjelden traktsoppaktige, mykorrhiza(sopprot)-dannende arter. I alt 24 arter innenfor *Rhodopolia*-gruppa er samlet og verifisert med DNA-sekvensering. Av disse er 10 nye for Norge og inkluderer også tre ubeskrevne arter. Fire forskjellige øko-geografiske elementer kan skilles ut: (i) det sørlige (boreonemorale) lind-eik-hassel-elementet, (ii) det boreal-arktisk-alpine selje-vier-or-bjørk-elementet, (iii) det arktisk-alpine dvergvier(-reinrose)-elementet, og (iv) det boreale bjørk(-gran)-elementet. Alle 24 artene kommenteres i den taksonomiske delen, ordnet etter de fem slektskapsgruppene (klader) som framkommer i den fylogenetiske analysen.

ABSTRACT

The rhodopolioid species of *Entoloma* (subgen. *Entoloma*) in Norway are presented. The rhodopolioid clade consists of tricholomatoid or collybioid, rarely omphalinoid, ectomycorrhizal species. Altogether 24 species of the rhodopolioid clade were recorded and verified by rDNA ITS sequence data, of which 10 are here reported as new to Norway, including three apparently undescribed species. Four different eco-geographical elements can be distinguished from our material; (i) the southern (boreonemoral) *Tilia-Quercus-Corylus*

element, (ii) the boreal-arctic-alpine *Salix-Alnus-Betula* element, (iii) the arctic-alpine *Salix*(-*Dryas*) element, and (iv) the boreal *Betula*(-*Picea*) element. All 24 species are commented in the taxonomic part, arranged according to the five well-supported clades from phylogenetic analyses.

INTRODUCTION

Entoloma is one of the most species-rich genera within *Agaricales*, well characterized by many-angled spores that leave a pinkish brown spore print. Like *Cortinarius*, it is one of the few remaining "mammoth-genera" which (at least in Europe) is still kept as one single genus and not split into several smaller genera, despite the large morphological, genetic and ecological variation across the numerous lineages (cfr. monographs of subgenera such as Morgado et al. 2013, Morozova et al. 2014, and regional fungas such as Jeppesen et al. 2012, Krieglsteiner and Gminder 2003, Ludwig 2007). The reasons for this comprehensive approach are manyfold, but are mainly based on the fact that variability in *Entoloma* is complex and still not fully understood, and more specifically, many clades in phylogenetic analyses show low support with the genetic markers applied so far (see e.g. Morgado et al. 2013). This fragile phylogenetic structure, combined with the manifest lack of data from *Entoloma* species from many parts of the world, makes it too preliminary to subdivide this mammoth into smaller genera.

Subgenus *Entoloma* is nevertheless one of the genetically, ecologically and morphologically better defined entities within the genus, especially since it apparently consists of (ecto)mycorrhizal species (Kobayashi and Hatano 2001, Sánchez-Garcia and Matheny 2016, Tedersoo et al. 2010). According to phylogeny, the mycorrhizal species in *Entoloma* can be subdivided into two well-supported clades, the rhodopolioid clade (including the type species of the genus *E. sinuatum*) and the Nolanidea clade (incl. *E. clypeatum* and allies). The latter group has apparently a special variant of mycorrhiza including parasitism, and is associated with wooden plants rarely forming (ecto)mycorrhiza, such as Rosaceae members like *Sorbus*, *Prunus* and *Malus*, as well as *Ulmus* (Kobayashi and Hatano 2001). The present paper will, however, only focus on the rhodopolioid species.

The rhodopolioid species can be distinguished from the *E. clypeatum* group (Nolanidea clade) at the section level (sect. *Entoloma*) or at the subgenus level (subgen. *Entoloma* = subgen. *Rhodopolia* s. Kokkonen 2015). The infrageneric taxonomy we do not consider further in this paper, and hence we preliminary apply the terms rhodopolioid clade and rhodopolioid species for our study group (cfr. also e.g. Sánchez-Garcia and Matheny 2016).

The rhodopolioid clade has been extensively treated by Noordeloos (1981, introducing sect. *Rhodopolia*, 1992, 2004) and by Kokkonen (2015 as subgen. *Rhodopolia*). The former studies were based on morphological taxonomy, whereas the latter also included DNA sequence data, focusing on boreal(-alpine) species from Finland. The rhodopolioid species are distinguished from many other *Entoloma* taxa by their (i) often large and robust basidiomata (although also small, tiny representatives occur), (ii) rather uniform predominantly brown, yellow-brown or grey-brown colours due to simultaneously encrusted-intracellular-plasmatic pigments (contrasting the often vivid colours seen in other groups), and (iii) often pronounced farinaceous or nitrous smells (Noordeloos 1981, 1992, 2004, Kokkonen 2015). The pileipellis structures are fairly simple, mainly a cutis or ixocutis of narrow, cylindrical hyphae, with or without a distinguishable subpellis layer of inflated, short elements. A number of species (e.g. *E. serpens*, *E. sericatum*) have fine hairs, particularly at the margin of young and fresh specimens, visible as pileocystidia, but these structures are ephemeral and disappear with age. Caulocystidia frequently occur at the apex of the stipe, variable in shape. Cheilocystidia are rarely differentiated, but seem to be characteristic and constant for some species. The spores show apparently little, taxonomic relevant variation, size variation mainly expressing size difference of two-spored versus four-spored basidia (Noordeloos 1981, 1992, 2004, Kokkonen 2015). Many species occur in moist forest-woodland-shrubland habitats, and a remarkable high percentage of the species seems to be associated mainly with *Salix*, *Populus*, *Betula* and *Alnus* hosts, including arctic-alpine habitats (Noordeloos 2004, Kokkonen 2015). Conifers such as *Picea abies* seem hardly to be involved in the mycorrhizae of the rhodopolioid species, although many boreal species occur in *Picea*-dominated forests (with presence of single trees of *Salix*, *Betula* and other frondose trees) (Kokkonen 2015, and this paper).

The present paper is part of the Norwegian *Entoloma* study 2015–2017, as part of The Norwegian Taxonomy Initiative and funded by The Norwegian Biodiversity Information Centre. It also includes data from a study on the *Entoloma* fungi of the Holmvassdalen nature reserve, Nordland (see e.g. Weholt et al. 2014, Noordeloos et al. in prep). The Norwegian *Entoloma* project has focused on *Entoloma* hotspot-habitats, such as calcareous (semi-)natural grasslands and calcareous forests, but due to moderately good fungal seasons in the grasslands, the collections from (calcareous) forests and semi-open woodlands contribute a considerably large amount of the data, including many samples from the rhodopolioid clade. Most of the study samples have been verified by rDNA ITS sequencing, mainly through NorBOL (Norwegian Barcode of Life Network; see Ratnasingham and Hebert (2007, 2013).

The present study focus on the ecology and distribution of the taxa recorded, based on ITS-sequence- and morphology data, with an emphasis on new species to Norway. At present, we have not sufficient sequence- and morphology data to present a detailed taxonomy of the group. In particular, more studies are needed on the morphological variation of our phylogenetic taxa, and to what degree they are possible to distinguish morphologically.

MATERIAL AND METHODS

Approximately 250 samples of rhodopolioid species have been collected during the Norwegian 2015–2017 *Entoloma* study, and 176 samples were verified by ITS sequencing. The latter number includes some herbarium collections. In addition sequences of six type specimens and some important reference material, not collected by us, were studied in connection with the present project. Sampling focused on boreonemoral and southern/middle boreal regions of SE Norway, where also other mycological field projects were carried out during the period. Further, many samples were obtained from North Trøndelag, C Norway, during a project foray in 2016, and many from the study of Holmvassdalen nature reserve, Nordland, including some alpine sites. All sequenced material from Norway is listed under material examined. Collections labelled NOBAS or CAFUN were sequenced through NorBOL, those labelled ALV were sequenced by Pablo Alvarado (ALVALAB, Spain), and those with no sequence label are original (B. Dima, in Budapest, ELTE). All sequences were analyzed by us (see below). Collector's numbers (ID's) are included with the following initials: AKS=leg. A.K.Svendsen; EB=leg. E. Bendiksen; GG=leg. G. Gulden; ILF=leg. I.-L.Fonneland; JBJ=leg. J.B.Jordal; JL=leg. J. Lorås; KK=leg. K. Kokkonen; MEN=leg. M.E. Noordeloos; MP=leg. M. Pettersen; OW=leg. Ø. Weholt; TEB=leg. T.E.Brandrud. All material is deposited or will be deposited in O (Botanical Museum, University of Oslo). For further data on each collection (habitat, coordinates), see herbarium database (http://www.nhm2.uio.no/botanisk/nxd/sopp/nsd_b.htm) and Artskart (https://artskart.artsdatabanken.no/app/#map/).

Morphology

The macromorphological observations are based on field notes and photographs of the material studied. Microscopical observations were made using standard methods (see e.g. Morozova et al. 2014).

Molecular study

DNA extraction, PCR amplification and sequencing followed Weholt et al. (2014) and Noordeloos et al. (2017). Chromatograms were checked and edited with the CodonCode Aligner package (CodonCode Corp., Centerville, Massachusetts, USA).

Multiple sequence alignment was performed with MAFFT v. 7 using the E-INS-i algorithm (Katoh and Standley 2013). Manual adjustment was done in SeaView (Gouy et al. 2010). Maximum Likelihood (ML) analysis was carried out using RAxML (Stamatakis 2014) implemented in raxmlGUI (Silvestro and Michalak 2012). Rapid bootstrap analysis and 1,000 replicates under the GTRGAMMA substitution model were used for the partitioned alignment (ITS1, 5.8S, ITS2). The phylogenetic tree was edited in MEGA 7 (Kumar et al. 2016).

RESULTS AND DISCUSSION

Based on our phylogenetic analysis of the ITS sequences, 24 well-supported, rhodopolioid operational taxonomic units (OTUs) were recognized, of which 10 taxa are new to Norway (Figure 1, Table 1). Some of these OTUs show overlapping morphological characters, and should be regarded as cryptic or semi-cryptic species (see further comments under taxonomic part). Among our 24 sequenced OTUs, 15 had a complete match with sequenced type materials (mainly sequenced by K. Kokkonen; six additional types originally sequenced), whereas six had a complete match with published reference materials (mainly from Morgado et al. 2013 and Kokkonen 2015), leaving three "nameless species" without a match with type or reference sequences.

An ITS phylogeny based on own sequences as well as sequences available from Kokkonen (2015) and other sources (GenBank, UNITE), distinguishes five well-supported (sub)clades within the rhodopolioid clade (Figure 1), the Sericatum clade, the Rubrobasis clade, the Sinuatum clade, the Rhodopolium clade, and finally the small Sordidulum clade, including only *E. sordidulum* s. Noordeloos in the Nordic countries. We present our rhodopolioid species according to these five clades. All 24 species are commented in the Taxonomic part, with focus on the 10 new ones. Our new/interesting species are found within all these five clades (Figure 1).

The material includes a remarkably high number of *Salix*-*Alnus* associates, and a remarkably low amount of coniferous forest associates, compared to other groups of ectomycorrhizal agarics (Table 1). Only one species (*E. boreale*) seems to be associated with *Picea* (or other conifers) in Norway, and since based only on one record, more data is needed to confirm this association. Altogether 11 species are mainly associated with *Salix* and *Alnus*, whereas five species seem to be associated (also) with *Betula* (Table 1). In other words, most of our Norwegian rhodopolioid taxa are associated with boreal deciduous trees, and many apparently with a wide range of hosts, but with preference for *Salix*-*Alnus*, and often in moist places. Altogether nine species are more or less exclusively associated with thermophilous deciduous trees (*Tilia, Corylus* and *Quercus*).

There is also a remarkably high amount of our species that have arctic-alpine populations,

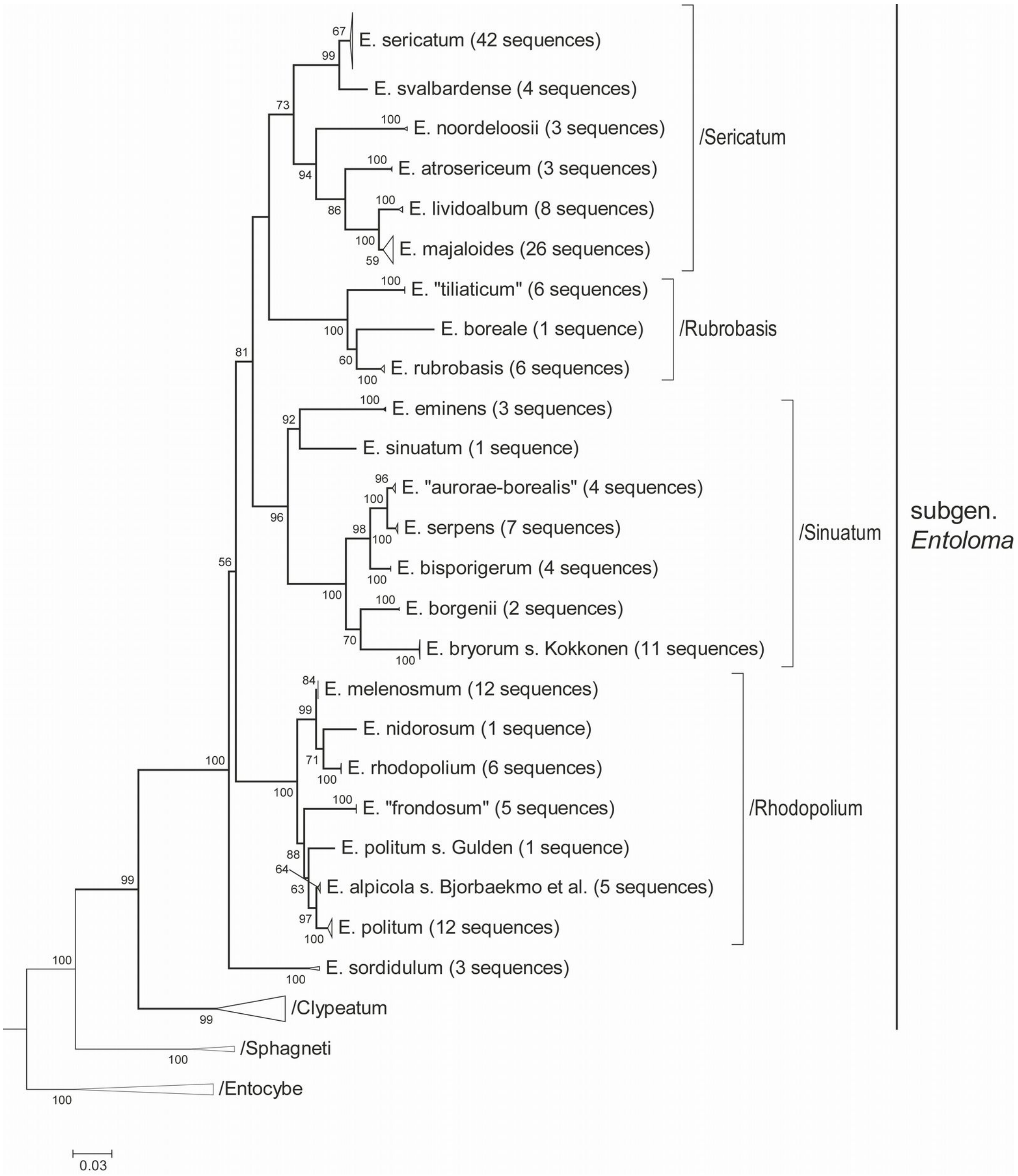

Figure 1. Phylogenetic tree inferred from 176 nrDNA ITS sequences from rhodopolioid species (sect./subg. *Entoloma*) using RAxML. The Clypeatum, Sphagneti and Entocybe clades served as outgroups. Bootstrap support values >50% indicated at branches. Terminal clades (i.e. the species clades) in the subg. *Entoloma* compressed.

associated with dwarf shrubs of *Salix* and *Dryas* (10 species; Table 1). These populations are often dwarfish, and often with so deviating features from the lowland populations, that they were described as own species. However, DNA sequencing with different molecular markers has shown that some of these very likely are conspecific with lowland species, such as *E. subarcticum* (=*E. sericatum*) (Kokkonen 2015).

Based on their preferences for mycorrhizal hosts, and preferences for boreonemoral, boreal or arctic-alpine habitats, four major eco-geographical groups/elements can be distinguished in Norway (cf. Table 1);

(i) the southern *Tilia-Quercus-Corylus* element
(ii) the boreal-alpine-arctic *Salix-Alnus-Betula* element
(iii) the arctic-alpine *Salix*(-*Dryas*) element
(iv) the boreal *Betula* (-*Picea*) element

It should be noted that some of the species with a more or less wide habitat range might be difficult to place in one of these elements. This is further commented under the presentation of each element below.

The southern Tilia-Quercus-Corylus element

In Norway/Fennoscandia this is a fairly strict boreonemoral element, following the distribution of *Tilia cordata* and *Quercus* spp., but some northern outposts can be found in warm, southern boreal *Corylus* thickets, north to lake Randsfjorden-Mjøsa in southeastern Norway, and north to Møre and Romsdal along the western Norway coast. Altogether nine species belong to this southern element (Table 1), often occurring both in parks and forests, and often in richer clayey to calcareous soils. The majority of species are found only/mainly in calcareous *Tilia-Corylus(-Quercus)* forests (*E. eminens*, *E. lividoalbum*, *E.* "*tiliaticum*", *E. noordeloosii*, *E.* "*frondosum*") and a few only/mainly in rich *Quercus* forests (*E. sinuatum*, possibly also *E. sordidulum* s. Noordeloos). One species was found mainly in parks with *Tilia* (*E. bryorum* s. Kokkonen). Some of the other above mentioned species are also collected in grassy parks (*E.* "*tiliaticum*" and *E. lividoalbum* near *Tilia*; *E. sinuatum*, near *Quercus*).

Entoloma rhodopolium deviate from the above described pattern, since it is found both in boreonemoral forests with *Corylus*(-*Tilia*), and southern boreal (coniferous) forests with *Betula*. Due to its mainly thermophilous distribution, it is placed here. *Entoloma nidorosum* s. Noordeloos is not possible to classify at the moment, but might belong here, based on the sole Norwegian collection from a thermophilous, mixed forest with *Corylus*, *Salix* and *Populus*.

Four of these species are new to Norway (Table 1) and two are new to Fennoscandia (see taxonomic part). Few of these southern taxa were reported in Kokkonen (2015) (only *E. bryorum* s. Kokkonen, *E. eminens*, *and E. lividoalbum*), who focused on the boreal element of rhodopolioid species in Finland. *Entoloma eminens* was reported by Kokkonen (2015) from boreal areas (near *Picea, Populus, Betula*), and with the present data it is not clear, whether this is a primarily boreal or a southern, boreonemoral species.

The boreal-arctic-alpine Salix-Alnus-Betula element

The six species belonging here occur both in boreal lowland areas and in arctic-alpine sites. Most collections of the boreal-arctic-alpine species are from the lowlands, but this could at least partly be due to a lowland sampling bias in our project. One of the species (*E. bisporigerum*) has not been found in arctic-alpine sites in Norway, but it has been recorded from an alpine site in Finland (Kokkonen 2015). The species we have included in this element, combines (i) a wide climatic range with an apparently often also (ii) a wide boreal deciduous tree host range, however, most with a preference for *Salix* and *Alnus*.

In the lowland sites, the species are found mainly in swampy-riparian forests or secondary habitats like road borders, parks, normally with *Salix* spp. and *Alnus* spp. Often *Betula* spp. and *Populus tremula* are also present on the sites, and seem to be important co-associates for this element. Especially for the two most frequent species, *E. sericatum* and *E. majaloides*, our data strongly indicate that these have a broad range of deciduous tree hosts. They often occur in sites with a lot of *Picea abies*, but never in pure stands (e.g. pure plantations) without some deciduous trees in close vicinity. Therefore, we find it highly unlikely, that these are able to associate with *Picea abies* (or *Pinus sylvestris*). Also *E. serpens* seems to be associated with a wide range of boreal, deciduous tree hosts, but is not found in very moist habitats. *Entoloma bisporigerum* and *E. politum* seem to be associated only with *Alnus* and *Salix* in moist places in their Norwegian lowland sites, and the same is observed in Finland (Kokkonen 2015). *Entoloma politum* is according to present material the only species occurring in extreme, seasonally inundated, flooded forests along larger rivers and inland deltas in Norway.

Most species seem to prefer somewhat richer, often clayey soils. Some species, such as *E. serpens*, seem to be more or less calciphilous, and some species, such as *E. sericatum*, seem to tolerate rather high nitrogen levels, occurring sometimes with nitrophytes like *Urtica dioica*, which is a rare habitat for mycorrhizal agarics.

Our results, with a remarkable high amount of *Salix-Alnus(-Betula-Populus)* associates, are well in correspondence with those of Kokkonen (2015) from Finland. Kokkonen specifically focused swampy-wetland *Salix-Alnus*-dominated habitats, and found many species associated with these vegetation types, including some species hitherto not found in Norway, as well. Of these, at least *E. paludicola* very probably occurs also in our areas, since recorded both from Finland and England (as well as records from the Alps; Kokkonen 2015).

The arctic-alpine Salix(-Dryas) element

This is a group of four species solely recorded from arctic-alpine regions; *E. atrosericeum*, *E. svalbardense*, *E. borgenii*, and *E. alpicola* s. Bjorbækmo et al. These are totally or primarily associated with dwarf *Salix* species (*S. herbacea*, *S. polaris*, *S. reticulata*) or *Dryas* (see comments in the taxonomic part). Some of the boreal-alpine *Salix* associates of the last element discussed above, might co-occur with the present ones in arctic-alpine *Salix* snowbeds. However, the taxa of the above discussed element has a much wider habitat range than the present ones, and more often occur in alpine shrub vegetation of larger *Salix* species, such as *S. glauca* and *S. lapponum*, as well as lowland moist forests. So it seems reasonable to distinguish the wide habitat range species from the more specialized arctic-alpine ones in two elements. Also in other large ectomycorrhizal fungal genera such as *Cortinarius*, *Inocybe* and *Hebeloma*, one find in the arctic-alpine zones a mixture of lowland *Salix* species and more specialized arctic-alpine taxa (Beker et al. 2016).

It seems probable that many of the species from the two latter elements have a wide, circumpolar distribution. Finds in Greenland of some of these (cfr. Kokkonen 2015), support this hypothesis. *Entoloma majaloides* has also been verified by sequencing from British Columbia, Canada (S. Berch, pers. comm.).

The boreal Betula(-Picea) element

Some species do not fit in the above mentioned patterns, and seems to be mainly associated with *Betula* or possibly *Picea*. This includes taxa from the clades Rubrobasis and Rhodopolia. In Norway *Entoloma rubrobasis* is recorded mainly near *Betula*, including mixed *Betula-Picea* forest margins of summer farms, but also near *Salix caprea*. *Entoloma boreale* has so far only one documented find from Norway, in a *Picea* forest apparently devoid of *Betula*, and *Picea abies* is also postulated as the major host for it in Finland (Kokkonen 2015). In Finland there is a couple of more species that seem *Picea-Betula* associated (*E. lupinum* and *E. radicipes* in the Sericatum clade). All these seem to be more or less northeastern “taiga-species” in Fennoscandia.

Within the clade Rhodopolium, *E. melenosmum* (*E. nidorosum* s. Kokkonen), seems to be mainly associated with *Betula*, in moist, both richer and poorer habitats, including *Sphagnum*. It should be noted that the boreonemoral-southern boreal *E. rhodopolium* in Norway seems to be associated mainly with *Corylus*, but also often with *Betula* in southern boreal, calcareous *Picea* forests.

Continental versus oceanic boreal species in Fennoscandia

In our Norwegian *Entoloma* project presented here and in the Finnish Kokkonen (2015) study altogether almost 300 collections from Fennoscandia (including Svalbard) were sequenced. With this high number, it should be possible to see whether there are some geographical east-west patterns. And, indeed, there are some striking differences between Norway and Finland. Firstly, there is a fairly high amount of boreal species not yet found in Norway (7 species), and then, there are some species that are clearly more frequent in Norway, such as *E. serpens*. These differences indicate that there are considerable geographic patterns within Fennoscandia for this group, and especially, there seems to be a group of continental species, with an apparently northeastern distribution in Europe. The arctic and alpine rhodopolioid species seem rather similar throughout Fennoscandia, and include some lowland species such as *E. majaloides*, *E. sericatum* and *E. politum*, which stand out as species with a very wide ecogeographical range. Finally, there is a group of southern, boreonemoral species in the Norwegian material not found in Finland, but this can be explained by the focus on boreal habitats in the Kokkonen (2015) study.

Taxonomic part/comments

Clade /Sericatum

***Entoloma sericatum* (Britzelm.) Sacc. (= *E. myrmecophilum* Romagn.)** Fig. 2 C, D, E

According to our material, this is the most frequent rhodopolioid species in Norway, with 42 Norwegian collections verified by sequencing. It is also common in Finland (Kokkonen 2015). Usually it has medium-sized, slender basidiomata (Figure 2). However, it is remarkably variable morphologically and ecologically, including large and robust versus small and tiny specimens, with or without farinaceous smell, dark to rather pallid, and with various degree of encrusted pigment in pileipellis hyphae, all these variants with identical ITS sequence. The ITS phylogeny thus shows that these features probably have a higher infraspecific character variation than formerly believed. Young basidiomata little exposed to rain and drought possess numerous fine whitish scales/hairs especially towards margin.

Although such fine hairs might be initially present in a number of rhodopolioid species, this feature is rarely as pronounced as here, and it could be a good differential feature towards resembling taxa. Kokkonen (2015) sequenced the type of *E. myrmecophilum*, which appeared to be conspecific with *E. sericatum*. Robust, dark variants of the present species with distinct encrusted pigment have apparently often been called *E. myrmecophilum*, whereas the more typical, slender, paler ones with no or little encrusted pigment have been assigned to *E. sericatum*.

Entoloma sericatum is apparently almost ubiquitous in Norway, found mainly in association with *Salix*, *Alnus* and often also *Betula* and *Populus,* from boreal(-boreonemoral) moist/swamp forest sites to arctic-alpine *Salix polaris-S. herbacea* snow beds (Figure 2). A typical habitat is moist, richer mixed forests with *Alnus incana-Betula pubescens-Salix caprea* along brooks or tall-herb types inclu-

Table 1.The rhodopolioid *Entoloma* taxa in Norway, and their habitat and distribution.
New Norw = New to Norway ((x) = formerly reported, but probably misidentified (name use not in accordance with type). Boreonemoral = boreonemoral zone (southern coastal zone); boreal = boreal zone, incl. subalpine (x) = only found in southern boreal. Svalbard = records from arctic zone (no records from (sub)arctic parts of Finnmark).

The most frequent group of hosts (*Salix/Alnus*) is marked in **bold**. Salix/Alnus = *Salix* spp., *Alnus incana*; found predominantly with *Salix* spp. (and often *Alnus incana*) in moist habitat, also in parks/roadborders with *Salix caprea*. Betula/Populus = *Betula* spp., *Populus tremula*: found in moist *Betula* forests (or parks), or *Picea* forests with *Betula and Populus* (never pure *Picea* forests). Tilia/Quercus: found in calcareous *Tilia cordata-Corylus avellanea* forests, *Tilia* or *Quercus* forests/parks, or *Corylus* coppices. *Picea*: found in pure stands with *Picea abies*. KK = Kokkonen, MEN = M. E. Noordeloos.

rhodopolioid taxa in Norway	**Total seq.**	**New Norw**	boreo-nemoral	boreal	alpine	Svalbard (arctic)	**Salix/ Alnus**	Betula/ Populus	Tilia/ Quercus	Picea
Clade Sericatum:										
E. majaloides	**26**	**(x)**	x	x	x		**x**	x		
E. lividoalbum	**8**		x	(x)					x	
E. atrosericeum	**3**				x	x	**x**			
E. svalbardense	**3**					x	**x**			
E. sericatum	**42**		x	x	x	x	**x**	x		
E. noordeloosii	**3**	**x**	x	(x)					x	
Clade Rubrobasis:										
E. boreale	**1**	**x**		x				?		x
E. rubrobasis	**6**	**x**		x			**?**	x		
E. "tiliaticum"	**6**	**x**	x						x	
Clade Sinuatum:										
E. sinuatum	**1**		x						x	
E. eminens	**3**	**x**	x						x	
E. serpens	**7**	**x**	x		x		**x**	x		
E. "aurorae-borealis"	**4**	**x**			x		**x**			
E. bisporigerum	**4**		x	x			**x**	?		
E. borgenii	**2**				x	x	**x**			
E. bryorum s. KK	**11**		x						x	
Clade Rhodopolium:										
E. rhodopolium	**6**		x	(x)				x	x	
E. "frondosum"	**5**	**x**	x						x	
E. politum	**12**		x	x	x		**x**			
E. politum s. Gulden	**1**				x		**x**			
E. alpicola s. Bjorbækmo et al.	**5**				?	x	**x**			
E. melenosmum	**12**		x	x			**?**	x		
E. nidorosum s. MEN	**1**	**x**	x						?	
Clade Sordidulum:										
E. sordidulum s. MEN	**3**		x						x	
24 species	**176**	**10**	16	10	7(8)	5	**11**	6	9	1

ding nitrophilous sites, and also parks and roadside verges. A few finds are boreonemoral from SW Norway, from mixed deciduous forests with *Betula*, *Populus*, *Corylus and Quercus* (leg. A.K. Svendsen). Some collections are alpine, and the species is also verified from Svalbard (Spitsbergen) (leg. and det. A. Molia 43-2015; E. Larsson).

Material examined (including sequencing): Akershus, Asker, TEB 390-15 (NOBAS2115-16); Akershus, Asker, TEB 573b-17; Hordaland, Ulvik, EB297/80 (NOBAS4077-17); Møre og Romsdal, Rindal, O-F-249623, GB59-14 (NOBAS1500-15); Nordland, Grane (Dunfjellet), JL22-13 (ALV5328); Nordland, Grane (Dunfjellet), JL65-16 (ALV11362); Nordland, Grane (Holmvassdalen), JL83-14 (ALV4965); Nordland, Grane, JL20-13 (ALV5003); Nordland, Grane, JL52-16 (ALV11356); Nordland, Grane, MEN2010307; Nord-Trøndelag, Levanger, TEB 273-16 (NOBAS4347-17); Nord-Trøndelag, Steinkjer, TEB 273-16 (NOBAS4337-17); Nord-Trøndelag, Steinkjer, ODFL7029, TEB 306-16 (NOBAS4517-17); Nord-Trøndelag, Steinkjer, KK324/16 (NOBAS4536-17); Nord-Trøndelag, Steinkjer, TEB 304-16 (NOBAS4538-17); Nord-Trøndelag, Steinkjer, TEB 305-16 (NOBAS4540-17); Nord-Trøndelag, Steinkjer, KBEB105-16 (NOBAS4578-17); Oslo, Oslo, EB232/15 (NOBAS2243-16); Oslo, Oslo, EB773/11 (NOBAS4681-17); Rogaland, Strand, AKS-13-16 (ALV11027); Rogaland, Strand, AKS-43-16 (ALV11026); Rogaland, Strand, AKS-E1-14 (ALV4400); Rogaland, Strand, AKS-E4-14 (ALV4935); Svalbard, AM43-2015 (NOBAS2346-16); Svalbard, E. Larsson (NOBAS2171-16); Sør-Trøndelag, Rissa (Gurulia), OW-E6-13 (ALV6782); Østfold, Fredrikstad (Gansrød), OW-E27-17 (ALV-14246); Østfold, Fredrikstad (Hunnfeltet), MP-5-161015 (ALV6340); Østfold, Fredrikstad (Torpelund), MP-4-280915 (ALV6338); Østfold, Fredrikstad, Hunnfeltet, MP-10-110914 (ALV6774); Østfold, Fredrikstad, MP-1-031013 (ALV5661); MP-1-050914 (ALV5140); MP-1-220915 (ALV6335); MP-1-230914 (ALV5145); MP-17-070914 (ALV5141); MP-2-250816 (ALV10936); MP-3-170915 (ALV6771); MP-4-041014 (ALV5143); MP-6-170916 (ALV10935); MP-7-081114 (ALV4996); MP-8-060914 (ALV4995); MP-9-041014 (ALV5147).

***Entoloma svalbardense* Noordel.**
This sister species to *E. sericatum* seems to be mainly arctic, collected in *Dryas* heaths. In Norway the species has so far been found only at Svalbard, but one collection is verified from alpine region of N Sweden (E. Larsson, pers. comm.). Four records from Svalbard have been verified by sequencing, namely the type (Kokkonen 2015), another collection sequenced in NORBOL (leg. A. Aronsen), and two soil samples sequenced in Geml et al. (2012). Although close to *E. sericatum* (with 8 nucleotide differences in ITS1; Kokkonen 2015), the *E. svalbardense* cluster is almost 100% supported in the phylogeny (Figure 2). When dwarfish variants of *E. sericatum* occur in the same habitat (Svalbard), the morphological variation of the two species is apparently considerably overlapping, but *E. svalbardense* is distinguished on the presence of cheilocystidia (Noordeloos 2004). Furthermore, *E. svalbardense* is noted mainly from *Dryas* heaths, whereas *E. sericatum* in alpine-arctic habitats seems to be more associated with dwarfish *Salix* in snow-beds. These differences need further documentation.

Material examined (including sequencing):
Svalbard, leg. A. Aronsen (NOBAS2311-16). [Svalbard, GG310/86 (O-74756; holotype, sequenced by Kokkonen 2011)]

***Entoloma majaloides* P.D. Orton** Fig. 2 A, B
Entoloma majaloides is, after *E. sericatum*, the second most frequent rhodopolioid species in Norway, with 26 verified collections within the *Entoloma* project. Most collections are from moist (coniferous) forests with *Betula*, *Salix* or *Alnus*, sometimes also *Populus*; often along paths, roadside verges, but some collections are also from alpine *Salix herbacea* snow-beds. *Entoloma majaloides* has been notoriously misidentified in Scandinavia, and has formerly never been verified in Norway nor in Sweden (cfr. Brandrud et al. 2017).

Figure 2. Illustrations of the *Entoloma* species in clade Sericatum. A, B) *E. majaloides,* A) 92TB09, B) JBJ6457; C, D, E) *E. sericatum,* C) JL65-16, D) MP10.11.09, E) TEB 390-15/DB5790; F, G) *E. lividoalbum,* F) TEB 610-15, G) ØW21-17; H, I) *E. noordeloosii,* H) TEB 62a-16, I) TEB 315-17. Photos: A) O. Morozova; B) J.B. Jordal; C) J. Lorås; D) M. Pettersen; E, F, I) B. Dima; G) Ø. Weholt; H) K.H. Brandrud.

One reason for misinterpretation is the name, indicating that this is an early species fruiting in May. However, according to our material so far, it has a season very similar to other *Salix-Betula* species (such as *E. sericatum*) of the rhodopolioid clade in Scandinavia, fruiting from July.

Entoloma majaloides usually has firm and robust basidiomata, which can be distinguished from the robust variant of the often co-occurring *E. sericatum* on the slight olivaceous-yellow-ochre tinge on the pileus (Figure 2 B), especially in the first phases of drying out. This tinge might resemble that of some *Tricholoma* species like *T. saponaceum* agg. or *T. arvernense*. Furthermore, young specimens of *E. majaloides* lack the fine white hairy-flocculose pileus margin seen on young, undisturbed *E. sericatum*. *Entoloma majaloides* differs from the large *E. eminens* basidiomata by absence of a tomentose-hirsute stipe base and presence of an olivaceous-yellow-ochre tinge on the pileus. Finally, it differs from the large *E. lividoalbum* basidiomata by a different habitat (see below).

Material examined (including sequencing): Akershus, Bærum, TEB 878-04 (NOBAS4078-17); Hordaland, Ulvik, GG13-04 (NOBAS4121-17); Nordland, Grane (Holmvassdalen), JL77-16 (ALV11365); Nordland, Grane, MEN2010306 (N42); MEN2010301 (N44); Nord-Trøndelag, Namdalseid, KK (NOBAS4342-17); Nord-Trøndelag, Steinkjer, HH140/16 (ALV11318); Nord-Trøndelag, Steinkjer, TEB 296-16 (NOBAS4355-17); Nord-Trøndelag, Steinkjer, H. Schwencke (NOBAS4537-17); Nord-Trøndelag, Stjørdal, JB Jordal (NOBAS2208-16); Nord-Trøndelag, Verdal, EB173/09 (NOBAS2592-16); O-F-248391, TEB 63-11 (NOBAS968-15); Oppland, Lesja, O-F-249083, TEB 153-13 (NOBAS1016-15); Oppland, Lesja, O-F-249385, TEB 589-13 (NOBAS1069-15); Oppland, Lunner, EB143/06 (NOBAS2579-16); Oppland, Lunner, EB45-16 (NOBAS4229-17); Oppland, Lunner, EB30-16 (NOBAS4238-17); Oppland, Øystre Slidre, O-F-249261, TEB 412-13 (NOBAS1036-15); Oslo, Oslo, EB18/16 (NOBAS4460-17); Rogaland, Strand, AKS-E2-15 (ALV7175); Sør-Trøndelag, Oppdal, JBJ3077 (NOBAS2197-16); Sør-Trøndelag, Oppdal, JB16531 (NOBAS4566-17); Telemark, Porsgrunn, O-F-249313, TEB 481-13 (NOBAS1053-15); Østfold, Fredrikstad (Gansrød), OW-E5-9 (ALV10651); Østfold, Fredrikstad (Regimentsmyra), MP-3-260915 (ALV6342); Østfold, Fredrikstad, MP-18-130914 (ALV6772).

***Entoloma lividoalbum* (Kühner & Romagn.) Kubička** Fig. 2 F, G; Fig. 5 A

Entoloma lividoalbum is characterized by fairly large and often robust and firm basidiomata with grey-brown to more yellow-brown pilei, white, clavate to radicate stipes, farinaceous smell and taste, and occurrence in Norway mainly in calcareous *Tilia* forests or parks.

The name *E. lividoalbum* has probably been applied in a broad sense by many authors, but frequently it seems to have been applied to the present species. The present interpretation is also in accordance with that of Kokkonen (2015; = *E. saussetiense*).

Entoloma lividoalbum is a thermophilous, deciduous forest species in Norway, with eight verified collections; half of them from calcareous *Tilia-Corylus* forests in inner Oslofjord-Tyrifjord (Akershus: Bærum, Asker; Oslo: Oslo; Buskerud: Hole), two from grassy *Tilia* parks in Østfold (Fredrikstad), one from rich, low-herb *Quercus-Corylus* forest in southernmost Norway (Aust-Agder; Grimstad), and, finally, one record from a southern boreal outpost of calcareous *Corylus* forest in Oppland, Lunner. According to Noordeloos (1992), the species in W/C Europe often occurs in open *Quercus-Fagus-Castanea* forests/parks.

There is a lot of collections labelled *E. lividoalbum* in Norwegian herbaria (see Artskart, the Norwegian species database), but most of them are probably misidentifications, including many boreal finds, which could represent *E. majaloides* or stout variants of *E. sericatum*. To do a proper revision of these, the material will need sequencing, and such a herbarium revision is beyond the scope and time of our project. The species was verified by sequencing only once from Finland, collected near *Tilia* (Kokkonen 2015, based on a partial sequence).

Material examined (including sequencing): Akershus, Asker, TEB 531-15 (CAFUN066-17); Akershus, Bærum, TEB 610-15 (CAFUN077-17); Aust-Agder, Grimstad, ILF6804 (NOBAS4076-17); Buskerud, Hole, TEB 314-17 (N14); Oppland, Lunner, TEB 115-04 (NOBAS4736-17); Oslo, Oslo, EB184/04 (NOBAS4721-17); Østfold, Fredrikstad, OW-E21-17 (ALV13238); Østfold, Rygge, OW-E22-17 (ALV13746).

***Entoloma noordeloosii* Hauskn.** Fig. 2 H,I; Fig. 5 B

This thermophilous species was first verified for the Nordic countries in 2017, with three records from deciduous forests sites. Two records were from south-faced, rich *Tilia-Quercus-* forests; one calcareous site at Buskerud, Hole (Brandrud et al. 2017) and one moderately calcareous at Telemark, Kragerø. Finally, one record from a rich *Corylus* coppice outpost at Møre & Romsdal, Aure (leg. F. Oldervik) was verified as *E. noordeloosii*. It is otherwise known only from a few *Quercus-Carpinus-Corylus* localities in Austria (Noordeloos 2004), and a few colline *Quercus-Carpinus* sites of NW Caucasus (O. Morozova, pers. comm.). This seems to be a true rarity, confined to thermophilous deciduous forests, and so far not found in secondary habitats such as parks.

Entoloma noordeloosii is characterized by a slender habit, often caespitose growth, pale grey-brown, strongly hygrophanous pileus, becoming whitish when dry, and a white stem with a (sub)radicate base (Figure 2 H,I), often discolouring slightly yellowish at base (or where damaged by insects), almost lack of encrusted pigments in pileipellis and presence of cheilocystidia. In one collection we also observed considerably darker brownish grey colours when young, little exposed and water-soaked (Figure 2 I). We noticed a faint, sweetish smell, a nut-like smell was noted from Russian material (O. Morozova, pers. comm.), whereas a faint farinaceous smell was noted in the original description (see Noordeloos 2004). The species might resemble pale taxa in the *E. rhodopolium* complex, but these have a more or less nitrous smell, usually a tomentose-hirsute stipe base and no cystidia. *Entoloma lividoalbum* occurs in similar habitats, but is more robust, darker (never whitish when dry), usually has a stronger farinaceous smell and no cystidia. Another potentially co-occurring species, *E.* “*tiliaticum*”, has a much darker pileus and a stronger farinaceous smell.

Material examined (including sequencing): Buskerud, Hole, TEB 315-17; Møre & Romsdal, Aure, O-F-188842, F. Oldervik 536.04 (NOBAS4720-17); Telemark, Kragerø, TEB 62a-16 (NOBAS4157-17).

***Entoloma atrosericeum* (Kühner) Noordel.**

According to our phylogeny, *E. atrosericeum* is related to *E. noordeloosii* (Fig. 1), but these differ in most respects as to morphology and habitat; *E. atrosericeum* being a dark, almost blackish, mealy-smelling, dwarfish alpine species, associated with dwarf-*Salix* species (and *Dryas*). We confirmed its identity by sequencing two Svalbard-collections and one S Norwegian alpine collection. There are more alpine collections from Northern Sweden (E. Larsson, pers. comm.).

Material examined (including sequencing): Hordaland, Ulvik (Hardangervidda), G. Flatabø (NOBAS4116-17); Svalbard, A. Molia 2015

(NOBAS2342-16); Svalbard, A. Molia 2015 (NOBAS2372-16).

Clade /Sinuatum

Entoloma bryorum Romagn. s. Kokkonen

Fig. 3 F

Entoloma bryorum s. Kokkonen (2015) seems to be a very little known species. It was verified by sequencing from 11 collections quite locally in Østfold, Fredrikstad-Sarpsborg district, and one from Oslo. It was recorded mainly form a couple of parks, but also from grassland-margins. The parks with large populations were dominated by *Tilia*, but also with some park trees of *Quercus* and *Carpinus*. The lack of finds from other parts of Norway indicates that *E. bryorum* is a southern species in our regions. This is in accordance with Kokkonen (2015), who reports only two southern, boreo-nemoral finds; one from Sweden (*Tilia* park) and one from Finland (moist forest with *Tilia cordata* and *Alnus glutinosa*).

The species is characterized by rather small basidiomata, with depressed-papillate pilei with a pale greyish brownish to dark (brownish) grey colour (Fig. 3 F) (often dark papillae contrasting to paler outer part), and a weak farinaceous smell and taste. With its small, depressed-papillate basidiomata, it might resemble *E. politum*, but the latter is distinguished, e.g., by the habitat (moist *Alnus-Salix* forests/copses/wetlands) and the differently shaped and sized spores. It might also resemble another southern species in Norway, *E. sordidulum*, but the latter has a strong farinaceous smell and hardly depressed pileus.

Material examined (including sequencing): Oslo, Oslo, leg. T. Jacobsen (NOBAS3208-16); Østfold, Sarpsborg (Hafslundparken), MP-E3-14 (ALV4396), MP-10-010914 (ALV4685), leg. M. Pettersen (NOBAS3140-16), leg. M. Pettersen (NOBAS3160-16), OW-E20-15 (ALV6051), OW-E6-15 (ALV6791), OW-E9-15 (ALV5697); Østfold, Sarpsborg (Borregårdsparken), MP-8-010914 (ALV4991); Østfold, Fredrikstad, MP-9-090815 (ALV6057), OW-E4-10 (ALV11035).

Entoloma borgenii Noordel. Fig. 6 B

This species is closely related to *E. bryorum* as here circumscribed, but differs in darker pileus, habitat and distribution. The Norwegian sequenced collections were characterized by dark, glossy, umbonate-papillate to depressed-umbilicate pileus, and slightly decurrent lamellae. It is mainly an arctic-alpine taxon associated with *Salix* (dwarf) shrubs, but is also collected in lowland *Salix* copses in eastern and northern Finland (Kokkonen 2015). In our project, *E. borgenii* was confirmed twice by sequencing; from alpine and subalpine/northern boreal habitats in Nordland, Holmvassdalen nature reserve. The species is formerly reported also from Svalbard (Noordeloos 2012).

Material examined (including sequencing): Nordland, Grane (Holmvassdalen NR), JL51-16 (ALV11355); JL63-16 (ALV11360).

Entoloma bisporigerum (P.D. Orton) Noordel. s. lat. (= *E. alnobetulae* (Kühner) Noordel.) Fig. 3 E

This species often has the omphaloid habit of *E. bryorum* and *E. politum*, with a depressed pileus with translucently striate margin (Noordeloos 1981, 1992). However, in the Norwegian material, the pileus has been more flattened than depressed and with little or no striate margin (Figure 3). Furthermore, it differs from *E. bryorum* and *E. politum* in the normally large spores from 2-spored basidia (Noordeloos 1981, 1992). However, according to Kokkonen (2015), the species might occur with 4-spored basidia and smaller spores, as well. *Entoloma politum* differs in often having a slightly nitrous smell.

Entoloma bisporigerum was within our project verified with sequences from four

Figure 3. Illustrations of the *Entoloma* species in clades Rubrobasis and Sinuatum. A, B) *E. tiliaticum* ined., A) TEB 211-14, B) EB169-15; C) *E. boreale* EB28.08.2014; D) *E. rubrobasis* JBJ-HH6619; E) *E. bisporigerum* ØW E20-14a; F) *E. bryorum* ØW E4-10. Photos: A) K.H. Brandrud; B, C) E. Bendiksen; D) J.B. Jordal; E, F) Ø. Weholt.

collections; three of them from Østfold, Fredrikstad region leg. M. Pettersen, det. Ø. Weholt), and one from Møre & Romsdal, Rindal (leg. G. Bureid). Formerly it was reported (not confirmed by sequencing) also from northern Norway (Tromsø; Noordeloos 2012). The Norwegian collections are from moist forests with *Salix* and *Alnus* mainly on clay soils. According to Kokkonen (2015) in Finland “it occurs rather commonly in old *Salix* thickets or moist forests on shores of lakes and rivers, often together with *E. politum* and *E. borgenii*.” Kokkonen (2015) mentions also one alpine collection near

Salix glauca, *S. herbacea* and *Betula nana*. According to Noordeloos (1981, 1992) the species is not uncommon in western Europe, in moist forests mainly with *Alnus glutinosa* and *Salix* spp., and often together with *E. politum*.

Material examined (including sequencing): Møre og Romsdal, Rindal, GB69-14 (ALV4607); Østfold, Fredrikstad, MP-1-240816 (ALV10937); Østfold, Fredrikstad, OW-E23-14 (ALV8408); Østfold, Fredrikstad (Hunnfeltet), MP-E2-14 (ALV4192).

***Entoloma serpens* Kokkonen** Fig. 6 A

Entoloma serpens is, together with its sister species *E.* "*aurorae-borealis*" (see below), characterized by a (very) dark, umbonate pileus, being fine rimose-hairy-scaly at umbo and initially often at margin, sometimes also with a slightly rugulose-irregular pileus surface. Both species possess cheilocystidia. Both are associated mainly with *Salix*, but the former mainly in the lowlands, the latter so far only in alpine habitats.

Entoloma serpens is reported new to Norway within the present *Entoloma* project (Noordeloos et al. in prep.). It is now verified from seven Norwegian localities, mainly in the boreonemoral Oslofjord region (preferentially near *Salix caprea*, but probably also *Betula*, mainly on calcareous ground), with one northern outpost recorded in alpine zone in Nord-Trøndelag (Levanger, Øvre Forra nature reserve, the Hårskallen mountain). The species will be further described and commented in Noordeloos et al. (in prep.).

Material examined (including sequencing): Buskerud, Røyken (Bøsnipa), TEB 748-13; Nord-Trøndelag, Levanger (Øvre Forra NR), EB94-16 (NOBAS4433-17); Østfold, Fredrikstad (Hunnfeltet), MP-1-240915 (ALV6770), MP-7-130915 (ALV6339), MP-E1-14 (ALV4191); Østfold, Fredrikstad (Tofteberg), MP-5-060815 (ALV6344); Østfold, Fredrikstad (Vesten), MP-2-120914 (ALV4992).

***Entoloma* "*aurorae-borealis*", ined.**

This species is recorded from four alpine sites with *Salix herbacea* snow-beds within the Holmvassdalen nature reserve, Grane, Nordland, and will be described as new to science and further commented in Noordeloos et al. (in prep.). For differences towards the closely related *E. serpens*, see above.

Material examined (including sequecing): Nordland, Grane (Holmvassdalen NR, Dunfjellet), JL67-16 (ALV11364), JL118-16 (ALV11374); Nordland, Grane (Holmvassdalen NR), JL85-14 (ALV4625), JL10-15 (ALV6511).

***Entoloma sinuatum* (Bull.) P. Kumm.**

The poisonous *E. sinuatum* has characteristic, large and robust basidiomata, being the only European rhodopolioid species with initially distinctly yellow lamellae (Noordeloos 1992). It is well-known and has for a long time been precisely identified in Norway due to its toxicity. Thus, it has not been given priority in our project (only one Norwegian collection was sequenced; see Figure 1).

According to the national species database (Artskart) and the Norwegian red-list fact-sheet (https://www.artsdatabanken.no/Rodliste) the species is known from approx. 30 localities in Norway, restricted to the Oslofjord region, and the southernmost coastal region (coast of Agder) with one outpost near *Quercus* in Møre og Romsdal. Only in the southern Agder coast region the species is more or less regularly recorded. Finds from the Oslofjord region are few and partly old (e.g. from Asker). In the Fredrikstad area, Østfold (outer Oslofjord), where the rhodopolioid species are well investigated, it is recorded only at a few sites at Kråkerøy (known from the1960ies and refound recently). Most collections are from richer (but rarely calcareous) low-herb, rather open *Quercus* forests, sometimes mixed *Quercus-Corylus*(-*Tilia*) forests. Although intensively investigated, we have never recorded this one in our calcareous *Tilia*(-*Corylus*) forests. It seems thus to be a more or less strict associate of *Quercus* in Norway.

Material examined (including sequencing):
Aust-Agder, Arendal (Vigeland/Bjellandshaugane NR), O-F-75429, IL Fonneland 09.09.2014 (NOBAS107-14).

***Entoloma eminens* Kokkonen**
Entoloma eminens is a striking species, being large and tall, with prominent hirsute-tomentose stipe base. It was described by Kokkonen (2015) from eastern and northern Finland, from rich *Picea abies* dominated forests, with presence of deciduous trees such as *Populus tremula* and *Betula*. From Norway, the species is verified from three collections from a boreo-nemoral calcareous *Tilia(-Corylus)* forest (Telemark, Bamble). These are the first finds outside Finland. Whereas most other species in Norway seem to have either a clear preference for thermophilous deciduous trees or boreal deciduous trees/shrubs, this seems to be a "crossover", being associated with *Tilia-Corylus* in SE Norway, and apparently with *Populus* and *Betula* in Finland (see further details in Noordeloos et al. in prep.).

Material examined (including sequencing):
Telemark, Bamble (Høgenheitunellen W), O-F-248409, TEB 97-11 (NOBAS971-15); TEB 226-16 (CAFUN098-17); TEB 699-17.

Clade /Rubrobasis
***Entoloma rubrobasis* Noordel.** Fig. 3 D; Fig. 6 C
This species is characterized by often rather large, slender basidiomata with (dark) brownish grey convex-umbonate pileus, initially greyish lamellae and white to pale greyish stipe, with a reddening base (Figure 3). The reddish spots at the stipe base are a good separating character (otherwise the species may look very much like e.g. *E. sericatum*), but it is not constant. However, on all our six sequence-verified collections at least a couple of specimens had reddish spots.

The verified collections are mainly from central-northern Norway (north part of Møre & Romsdal, Nord-Trøndelag, Nordland), including one from western Norway (Bergen district). The species is said to be rather common in Finland, at least in eastern Finland (Kokkonen 2015). So based on available data, it seems to be a mainly northeastern species in Fennoscandia, and probably in Europe as a whole.

The Norwegian finds seem to be mainly near *Betula* in secondary habitats along forest margins. It was found amongst tall-herbs in margins of semi-natural grasslands of summer farms (near *Betula* and some *Picea*), in grassy-mossy gardens/churchyards near *Betula*, and in one case also along a road near *Salix caprea*. Since *Picea* is a quite uncertain associate for rhodopolioid species in general (very few finds in pure *Picea*/conifer forests), *Betula* seems to be the major host of *E. rubrobasis*. According to Kokkonen (2015) the species occurs in a wide range of habitats in Finland, such as rich *Picea* forests, swamps, shore forests, and parks, but often growing near *Betula*. This characteristic species was first published for Norway by Holien et al. (2014) based on two finds from Nord-Trøndelag.

Material examined (including sequencing):
Hordaland, Bergen, H. Kivistø (ALV13101); Møre & Romsdal, Rindal, GB55-10 (NOBAS4699-17); Nordland, Grane (Holmvassdalen NR), O-F-249973, JL55-09 (NOBAS1595-15); Nord-Trøndelag, Steinkjer (Ulvensetran), H.Holien and J.B. Jordal (NOBAS2621-16); Nord-Trøndelag, Steinkjer (Egge church), H. Schwencke, TEB 295-16

(NOBAS4356-17); Nord-Trøndelag, Steinkjer, KK328/16 (NOBAS4533-17).

***Entoloma boreale* Kokkonen** Fig. 3 C
This unspectacular, *E. sericatum*-like species seems to have few distinguishing features. According to Kokkonen (2015), a more pronounced farinaceous smell could be a differential character towards look-a-likes such as *E. sericatum*. On average, the pileipellis hyphae of *E. boreale* are less encrustated than those of *E. sericatum*. Ecologically, the species is interesting, since it is one of very few with a seemingly major association with *Picea abies*. According to Kokkonen (2015), many finds are from rich to calcareous *Picea* forests, and the Norwegian find (Oppland, Etnedal) was from a pure, mesotrophic *Picea abies* forests (although presence of *Betula* at the site cannot be completely excluded). The species is not rare in Finland (Kokkonen 2015), and there is also a number of finds from Sweden (K. Kokkonen, pers. comm.). Judging from the data available, it seems, as its relative *E. rubrobasis,* to be a northeastern species in Fennoscandia/Europe.

Material examined (including sequencing):
Oppland, Etnedal (Breie), EB 28.08.2014 (NOBAS2576-16)

***Entoloma* "*tiliaticum*", ined.** Fig. 3 A,B
This species belongs to the thermophilous deciduous forest element, with most Norwegian finds from calcareous *Tilia* forests, but it is also found near *Tilia* in rich/calcareous soils in parks (Table 1). All six verified records are from the Oslofjord region. Four verified collections come from calcareous *Tilia* forests. From this habitat we have more non-sequenced collections, which very probably belong to the present species. Two verified collections are from parks. The species is characterized by a dark brownish grey (initially even almost blackish), glossy to finely rimose pileus, a pale greyish (never whitish), fibrillose stipe and a distinct farinaceous smell. The basidiomata are large to medium in size. On a few occasions, we have seen reddish spots at the base of stem, a feature otherwise seen only in the related *E. rubrobasis*.

The species has been found co-occurring with *E. lividoalbum*, but is distinguished by darker colours. The colour differences are even more pronounced against the pale *E. noordeloosii* and *E. rhodopolium* collections, which also occur in *Tilia-Corylus-Quercus* forests. However, discoloured mature/older specimens with paler pilei could be hard to distinguish, at least from *E. lividoalbum*.

The ITS sequence of the species gave no match with sequenced types or reference materials. Our species corresponds in many respects with the original description of *E. griseoluridum* (Kühner in Kühner & Romagnesi 1954). However, our species deviates in some important characters, for instance, in the protologue of *E. griseoluridum* Kühner mentioned a purplish tinge on pileus and stipe, never seen by us, so we regard these as two different species, and here treat the present one under the working name *E. "tiliaticum*". It has not been possible to obtain an ITS sequence of the type material of *E. griseoluridum*. Due to its dark pileus *E. "tiliaticum"* has been identified also as *E. gerriae*, possibly also as *E. griseopruinatum*, but the types of *E. gerriae* and *E. griseopruinatum* fall into other clades, and are thus not applicable. A few authors such as Ludwig (2007) have regarded *E. griseopruinatum* and *E. griseoluridum* as synonymous.

The species was not documented for Finland in the extensive study of Kokkonen (2015). However, it was found near *Tilia* in the Botanical Garden in St Petersburg (sequence-verified collections; O. Morozova, pers. comm.). Based on the rather many finds around the Oslofjord, and the Russian finds, the species probably has a wider boreonemoral-nemoral distribution in S. Sweden and in southernmost

Finland, probably showing a pattern very similar to that of *E. lividoalbum*.

Material examined (including sequencing): Buskerud, Røyken (Bøsnipa E), TEB 532-15 (NOBAS2120-16); EB169/15 (NOBAS2235-16); Oslo, Oslo, TEB 366-15 (NOBAS2113-16); TEB 367-15 (NOBAS2114-16); TEB 211-14 (T117); Østfold, Sarpsborg, Hafslundparken, OW-E21-15 (ALV6784).

Clade /Rhodopolium

Entoloma rhodopolium (Fr.) P. Kumm.

Fig. 4 A,B; Fig. 5 C

The *E. rhodopolium-E. nidorosum* complex in Norway includes a number of species that are morphologically and (partly) ecologically hard to distinguish. All these are slender, thin-fleshed, brittle, pale taxa with a convex to more depressed pileus, and with a more or less nitrous (chlorine-like) smell. The smell is rather variable and is perceived differently, sometimes compared to that of soap, and sometimes with a weak, sweetish, perfume- or apple-like component, but hardly farinaceous as in many other groups.

Entoloma rhodopolium is a classical, Friesian species, and was neotypified by Kokkonen (2015) on material from a beech forest in S Sweden. This is a southern, in Norway apparently mainly *Corylus-Betula*(-*Tilia-Quercus*) associated species, and mainly in calcareous forests, including calcareous *Pinus-Picea* forests with *Corylus*. It extends north to the southern boreal zone in SE Norway (Figure 5 C), where it occurs here and there in calcareous *Picea* forests near *Betula*. Since belonging to a critical complex, *E. rhodopolium* s. str. is difficult to identify without sequencing. So far we therefore have rather limited knowledge on the precise habitat preferences and distribution of this one. Altogether six collections have been sequenced, all from calcareous sites in the Oslofjord(-Randsfjord) area. At least three of them very probably were associated with *Corylus* (boreonemoral), at least one very probably with *Betula* (southern boreal). The species is strictly southern in Finland (Kokkonen 2015).

Material examined (including sequencing): Akershus, Bærum, EB20215 (NOBAS2239-16); Oppland, Lunner, EB165-16 (NOBAS4201-17); Oslo, Oslo, EB234/15 (NOBAS4600-17); Telemark, Porsgrunn (Frierflogene N), TEB 461-15 (NOBAS2118-16); Telemark, Porsgrunn, ILF2015-29 (NOBAS4317-17); Vestfold, Andebu, O-F-361608, P. Marstad 150-06 (NOBAS4714-17).

Entoloma "*frondosum*" ined. Fig. 4 C

This taxon is genetically well-defined, and rather dissimilar to the *E. rhodopolium* s. str. in ITS sequences (see Figure 1). However, these two are morphologically quite similar, and with overlapping habitat preferences (Table 1). All sequenced samples of the *E. rhodopolium*-complex from calcareous *Tilia* forests appeared to be this one (5 collections), so *E.* "*frondosum*" is probably the most common one in the calcareous *Tilia* forests, where the *E. rhodopolium* complex as such is frequent. So far the known distribution of this one is restricted to the Oslofjord district, and it is not known in other parts of Fennoscandia (Kokkonen 2015), but it is by us also verified from a *Carpinus* forest in Hungary, and there is a match with the UNITE sequence UDB 015210 from Estonia (V. Liiv, sub nom. *E. speculum*). So this seems to be a fairly widespread, more or less calciphilous, thermophilous frondose forest species (hence the working name *E.* "*frondosum*"), apparently associated mainly with *Tilia-Corylus-Carpinus* forests.

Material examined (including sequencing): Akershus, Asker, (Håkavikvegen), O-F-249276, TEB 432-13 (NOBAS1035-15); Akershus, Asker (Tverråsen), TEB 389-15 (CAFUN010-17); Telemark, Bamble (Røsskleiva), TEB 338-13

Figure 4. Illustrations of the *Entoloma* species in clade Rhodopolium. A, B) *E. rhodopolium,* A) EB202-15, B) TEB 461-15; C) *E. frondosum* ined. TEB 389-15; D) *E. nidorosum* MEN201220129; E, F) *E. melenosmum* E) RK E6-14, F) TEB 275-16; G, H) *E. politum,* G)TEB 44-15, H) DB6076. Photos: A) E. Bendiksen; B, C, D, H) B. Dima; D) M.E. Noordeloos; E) R. Kristiansen; G) K.H. Brandrud.

(NOBAS4700-17); Telemark, Bamble (Høgenheitunellen W), TEB 225-16 (CAFUN097-17); TEB 302-15 (CAFUN006-17).

***Entoloma melenosmum* Noordel. (= *E. nidorosum* (Fr.) Quél. s. Kokkonen)** Fig. 4 E, F
Entoloma melenosmum (= *E. nidorosum* s. Kokkonen 2015) appears to be a quite northern boreal-subalpine(-subarctic) species, rather well-distinguished from the others in the Rhodopolium (sub)clade by habitat and distribution. Morphologically, the species is on average more slender and with initially darker and more often depressed pileus than the other taxa in the complex. The stipe surface reminds often of *E. politum*. It has a variable, more or less nitrous to aromatic smell.

Altogether 12 Norwegian collections have been verified by sequencing, most of them from Trøndelag-Nordland in Central-North Norway. Most of our collections are from moist forests, swamps, along brooks, near *Betula*, a number also in subalpine *Betula* forests including young secondary forests/ forest rims towards grassland/lawns. The species is recorded in richer or poor soils, including *Sphagnum.* This is also in correspondence with habitats given in Kokkonen (2015). She interpreted this species as *Entoloma nidorosum* Fries (1838). However, Fries (1838) described it from rather open (park-like) deciduous forests around Uppsala ("in nemoribus frondos. circa Upsaliem"), which probably refers to the rich, at that time rather open *Quercus-Corylus(-Betula*) woodland around Uppsala, a habitat corresponding better with other, more southern taxa in the group.

Furthermore it was described as having a definite alcaline (nitrous) smell. *Entoloma melenosmum* is a more northern boreal-subarctic species, mainly in different, more acidophilic habitats, and probably does not correspond with the current usage of the name *E. nidorosum. Entoloma nidorosum* has often been treated as a variety or a form of *E. rhodopolium*, and should be morphologically very close to *E. rhodopolium* (Noordeloos 1992). For the moment, we name our northern species *E. melenosmum*, described from *Betula* forest on Greenland (Noordeloos 1984), and verified by sequencing of Kokkonen (2015), and the southern taxon is named here *E. nidorosum* sensu Noordeloos (1992).

Entoloma paragaudatum Kokkonen (2015), another boreal species in the complex, has so far not been recorded from Norway. It is similar to *E. melenosmum*, may be a bit darker, and is described from somewhat drier, calcareous forests with *Betula*, *Picea* and *Populus*.

Material examined (including sequencing):
Akershus, Fet (Øya, Fetsund), OW-E12-14 (ALV8405); Møre og Romsdal, Rindal (Aunesetra), GB54-14 (ALV3913); Møre og Romsdal, Nordal (Muldal), S.Vatne-E1-13 (ALV5493); Nordland, Grane (Holmvassdalen NR), JL62-16 (ALV11359); Nordland, Sørfold (Kobbelv), R. Kristiansen-E6-14 (ALV4692); Nord-Trøndelag, Levanger (Øvre Forrra NR, Hårskallen), TEB 274-16 (NOBAS4348-17); TEB 275-16 (NOBAS4349-17); Nord-Trøndelag, Steinkjer, O. Morozova (NOBAS4338-17); KK326/16 (NOBAS4534-17); KK325/16 (NOBAS4535-17); TEB 303-16 (NOBAS4539-17); Sør-Trøndelag, Rissa (Stadsbygd), EH-E1-17 (ALV14256).

***Entoloma nidorosum* Fr. s. Noordel.** Fig. 4 D
This is a more southern species than *E. melenosmum*, mainly of moist, mixed forests. It seems to represent the prevailing central-western European concept of *E. nidorosum* (see Noordeloos 1981, 1992), although some also treat *E. nidorosum* as a synonym of *E. rhodopolium* (Ludwig 2007). The present species is in the Nordic countries so far only confirmed from one, sequenced collection in Norway, from the Fredrikstad district (rich site near *Corylus*, *Populus*, *Salix*; leg. & det. Ø, Weholt). Morphologically, this seem indi-

stinguishable from *E. rhodopolium* in most stages, and it should probably be regarded as semi-cryptic species with the present knowledge.

Material examined (including sequencing): Østfold, Fredrikstad (Skremmelia), OW-E21-14 (ALV8407).

***Entoloma politum* (Pers.) Donk** Fig. 4 G, H
This species is widespread and rather common, mainly in moist forests, swamps and along rivers/lakes, near *Salix* spp. and *Alnus*, but occurs also in alpine *Salix* habitats (Fig. 4). *Entoloma politum* is characterized by small, omphaloid, often dark basidiomata, resembling *Entoloma bryorum* and *E. borgenii* from the clade Sinuatum, but differs e.g. by the often nitrous smell, which indicate its relationship with the *E. rhodopolium-E. nidorosum* complex. The species might also resemble the often co-occurring *E. bisporigerum*, but the latter normally has 2-spored basidia and larger spores. So far, the species has been verified from 12 collections from both southern and central Norway, including three alpine sites from Trøndelag-Nordland. However, we have visited only a few fairly typical *E. politum* habitats such as swamp forests and wetlands. Probably this is the most common rhodopolioid species in these habitats, and should be regarded as "undersampled". The species is frequent also in Finland (Kokkonen 2015).

Material examined (including sequencing): Akershus, Fet (Øya, Fetsund), OW-E13-14 (ALV6991); Akershus, Ullensaker, E.A. Thomsen (NOBAS4334-17); Nordland, Grane (Holmvassdalen NR, Dunfjellet), JL114-16 (ALV11372); Nordland, Grane (Holmvassdalen NR), JL88-16 (ALV11385); Nord-Trøndelag, Levanger (Øvre Forra NR, Hårskallen), E.A. Thomsen (NOBAS4343-17); B. Dima (NOBAS4345-17); Oppland, Sel (Otta, Nordre Veggem), TEB 115-15 (NOBAS2129-16); Oppland, Sel (Gudbrandsdalslågen ved Otta), O-F-251991, H. Schwencke, JBJ15-E08 (NOBAS2137-16); Oslo, Oslo, EB231/15 (NOBAS2242-16); Telemark, Kragerø (Sjåtjenna S), TEB 44-15 (NOBAS2127-16); Østfold, Rygge, E.W. Hanssen, R. Braathen (NOBAS2492-16); OW-E19-10 (ALV11040).

***Entoloma alpicola* (J. Favre) Bon & Jamoni s. Bjorbækmo et al.**
This is the *E. alpicola* as sequenced in connection with the study of *Dryas* mycorrhizae by Bjorbækmo et al. (2010) from Svalbard. When a number of *Entoloma*-collections from Svalbard were sequenced through NorBOL in 2016, this was the most frequent one, with four collections (and a fifth collection sequenced earlier). Neither notes nor photos are available from these Svalbard collections, so we have little data on our sequenced collections. A number of alpine collections from mainland Norway have been identified as *E. alpicola*, but at the moment, none of these have been verified by sequencing, and thus could include some of the other, alpine rhodopolioid species. With the present data, *E. alpicola* s. Bjorbækmo et al. is a strict arctic species in North Europe. The type of *E. alpicola* was, however, described by J. Favre from the Swiss Alps, and is not sequenced yet. We thus cannot confirm that our apparently frequent arctic *E. alpicola* is the true *E. alpicola* sensu Favre.

Material examined (including sequencing): Svalbard, 23-N1F31-2 (HQ445607); E. Larsson (NOBAS2327-16); (NOBAS2356-16); A. Molia 45-2015 (NOBAS2357-16); A. Molia 48-2015 (NOBAS2380-16).

***Entoloma politum* s. G. Gulden**
One collection identified as *E. politum* from *Salix herbacea* snow-bed in middle alpine zone at Finse, Hardangervidda came out as a well-supported sister species to *E. alpicola* s. Bjorbækmo et al. and *E. politum*. This seems

to be a new, undescribed, alpine species, with at present very little data. Noordeloos and Gulden (1989) reported *E. politum* from the Hardangervidda, based on five collections (not including the current one). So far these have not been sequenced, but shall be done in the near future, to find out whether they fit with this unknown species, or represent the true *E. politum*.

Material examined including sequencing):
Hordaland, Ulvik (Nordre Kongsnuten, Hardangervidda), leg. E. Søyland, det. G. Gulden, GG35/04 (NOBAS4726-17).

Clade /Sordidulum

Entoloma sordidulum (Kühner & Romagn.) P.D. Orton s. Noordeloos Fig. 5 D
This species has an isolated position within the rhodopolioid clade (Fig 1). We have so far three sequenced collections of it from Norway, one from W Norway (Hordaland, Tysnes, leg. P. Fadnes; margin of calcareous grassland, with *Corylus* and *Quercus*) and two from SE Norway (Østfold, Fredrikstad region, leg. Ø. Weholt, one from moist *Quercus* forest, the other from rich, rather open woodland, near *Corylus*, but also few *Quercus*). Our interpretation follows the concept of Noordeloos (1992), not that of Kokkonen (2015) (see below). *Entoloma sordidulum*, as applied here, is a small, convex-umbonate, greyish brown species, with non-striate pileus, a subpolished stipe, strongly farinaceous smell and taste and encrusting pigments in the pileipellis, looking somewhat like a small *E. sericatum*. This species (possibly in a wide sense) is frequent in large parts of northwestern and central Europe in thermophilous deciduous forests and parks, apparently with a preference for *Quercus* (Noordeloos 1992, 2012).

Kokkonen (2015) examined a syntype of *E. sordidulum* from the herbarium of Romagnesi in Paris, but did not find the lectotype. The syntype of *E. sordidulum* had the same sequence as the lectotype of *E. subradiatum*, and hence should be called *E. subradiatum*. *Entoloma subradiatum* (= syntype *E. sordidulum*) is quite distant from our species phylogenetically. It is a sister species to the *E. serpens*-*E. bisporigerum*-*E.* "*aurorae-borealis*" group in clade /Sinuatum (not shown), and presence of *E. subradiatum* is not yet confirmed from the Nordic countries.

Material examined (including sequencing):
Hordaland, Tysnes (Skorpeneset), O-F-75968, P. Fadnes (NOBAS928-15); Østfold, Fredrikstad (Skremmelia), OW-E25-17 (ALV14241); Østfold, Fredrikstad, OW-E18-14 (ALV8406).

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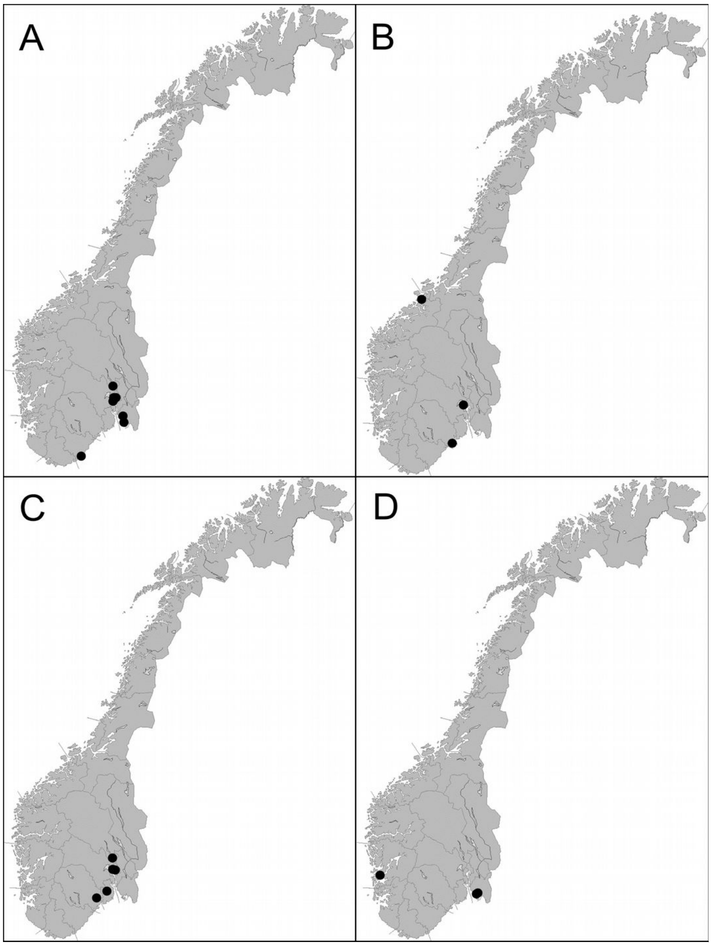

Fig. 5. Distribution maps of some of the rhodopolioid *Entoloma* species in Norway, belonging to the southern *Tilia-Quercus-Corylus* element. Only records verified by sequencing are included. A) *E. lividoalbum*; B) *E. noordeloosii*; C) *E. rhodopolium*; D) *E. sordidulum*.

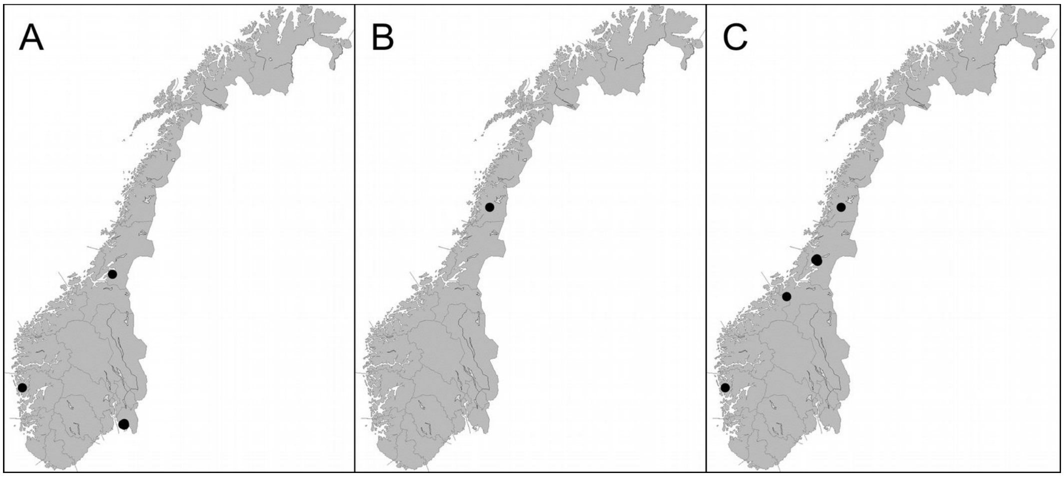

Fig. 6. Distribution maps of some of the boreal-arctic-alpine rhodopolioid *Entoloma* species in Norway. Only records verified by sequencing are included. A) *E. serpens* (the boreal-arctic-alpine *Salix-Alnus-Betula* element); B) *E. borgenii* (the arctic-alpine *Salix-Dryas* element); C) *E. rubrobasis* (the boreal *Betula* element).

Twenty species of bitunicate ascomycetes new to Norway

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Norsk tittel: 20 nye tykksekksopper for Norge

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KEYWORDS
Ascomycota, bark-living, Chaetothyriomycetidae, Dothideomycetes, wood-living

NØKKELORD
Barklevende, vedlevende, sekksporesopper, tykksekksopper

SAMMENDRAG

Tjue arter av ikke-lavdannende bitunikate sekksporesopper rapporteres nye for Norge: *Antealophiotrema brunneosporum, Botryosphaeria corticola, Capronia munkii, Capronia normandinae, Capronia parasitica, Capronia spinifera, Exosporiella fungorum, Helminthosporium oligosporum*, *Jahnula aquatica, Lophiostoma fuckelii, Lophiostoma rugulosum, Massaria macra, Massaria platanoidea, Massarina rubi, Moristroma quercinum, Navicella elegans, Poetschia buellioides, Splanchnonema pupula, Splanchospora ampullacea* and *Trematosphaeria hydrela.* Femten av arterne tilhører klassen Dothideomycetes (Tykksekksopper) og fem arter tilhører underklassen Chaetothyriomycetidae i klassen Eurotiomycetes (Kulsekksopper). De bitunikate sekksporesoppene er en lite studert og svært dårlig kjent soppgruppe i Norge, og det antas at det finnes et betydelig antall uoppdagete arter.

ABSTRACT

We here report the following 20 species of non-lichenized bitunicate ascomycetes as new to Norway: *Antealophiotrema brunneosporum, Botryosphaeria corticola, Capronia munkii, Capronia normandinae, Capronia parasitica, Capronia spinifera, Exosporiella fungorum, Helminthosporium oligosporum*, *Jahnula aquatica, Lophiostoma fuckelii, Lophiostoma rugulosum, Massaria macra, Massaria platanoidea, Massarina rubi, Moristroma quercinum, Navicella elegans, Poetschia buellioides, Splanchnonema pupula,*

Splanchospora ampullacea. and *Trematosphaeria hydrela.* Fifteen of the species belong in the class Dothideomycetes and five in the subclass Chaetothyriomycetidae of class Eurotiomycetes.

INTRODUCTION

Bitunicate ascomycetes

The Ascomycota is the largest phylum of fungi, consisting of 15 classes (Kirk et al. 2008). One of these classes, the Dothideomycetes, is the largest class of fungi, both regarding species richness and ecological diversity. Many dothideomycete species are endophytic or parasitic on various hosts, particularly vascular plants and lichens, some are lichenized, but most are saprobes, usually found in association with dead or dying plants (Hyde et al. 2013). The subclass Chaetothyriomycetidae of the class Eurotiomycetes is an assemblage of ecologically diverse species, with many saprobic, mycoparasitic, lichenized and bryophilic species, as well as human opportunistic pathogens (Gueidan et al. 2014).

Together Dothideomycetes and Chaetothyriomycetidae (Eurotiomycetes) may be referred to as non-lichenized bitunicate ascomycetes (but please note that bitunicate asci also occur in the mainly lichenized Arthoniomycetes). Under the microscope, they share the traits of bitunicate asci, branched and anastomozing sterile filaments (hamathecium), and often multiseptate ascospores, but the groups are otherwise extremely varied both regarding micro- and macro-characters. Bitunicate asci have a two-layered wall, the outer wall is thin and rigid, whereas the inner wall is thicker and elastic (Figure 1). At maturity the inner sac often stretches out of the outer sac that splits, and the spores are then forcibly ejected.

Figure 1. Bitunicate asci of *Splanchospora ampullacea* with ascospores (scale bar = 50 µm). Photo: H. Voglmayr.

The ascomata of bitunicate ascomycetes often resemble perithecia, but may also look like apothecia. A perithecium-like ascoma is called a pseudothecium. Some Dothideomycetes have larger ascomata called ascostromata and the technical difference from a pseudothecium is that an ascostroma has stromatic tissue containing several locules with asci, whereas in a pseudothecium there is only a single locule. A hysterothecium is an elongated ascoma that opens by a longitudinal slit (Figure 2).

For both Dothideomycetes and Chaetothyriomycetidae, the state of knowledge in Norway is poor to very poor regarding taxonomy, distribution and ecology (Elven and Søli 2016), and they have been subject to few if any myco-floristic surveys in Norway. A new biodiversity mapping project on this groups of fungi is starting in 2018 (presented on pages 78-82 in this vol of Agarica).

Dothideomycetes comprise about 620 known species in Norway (Elven and Søli 2016), while Chaetothyriomycetidae is a smaller group with about 50 known species in Norway following the system of Gueidan et al. (2014). Partly based on comparisons with the Swedish check-list (Eriksson 2014), Elven and Søli (2016) estimated that over 500 additional species may occur in Norway. In this paper, we present 20 species new to Norway.

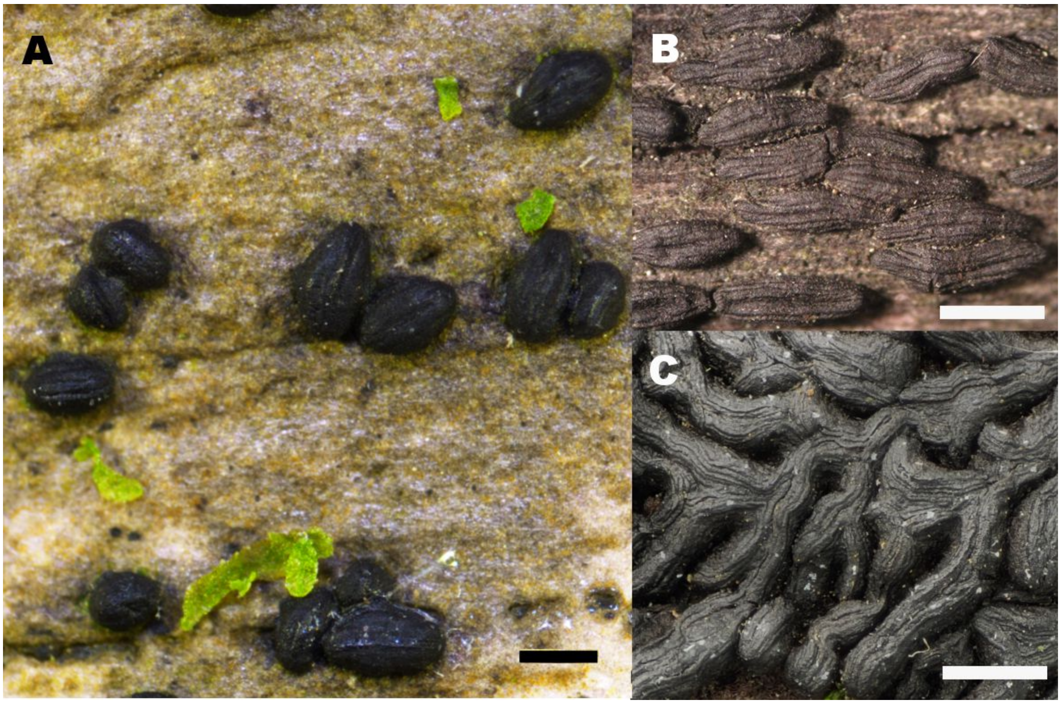

Figure 2. Hysterothecia lack pores and instead have slit-like openings. They come in various shapes but are usually black. A) *Hysterium pulicare*, a common species on the bark of various deciduous trees (scale bar = 0.5 mm). Photo: M. Jäntti, 2017. B) *Hysterographium flexuosum* (scale bar = 1 mm). Photo: J. Karakehian, 2016. C) *Glonium graphicum* (scale bar = 1 mm). Photo: C. Reisborg, 2012.

MATERIALS AND METHODS

The presented species were encountered in temperate deciduous forests in southern and western Norway and some of the sites are presented in Nordén et al. (2015).

The species were determined by studying the sexual morph (teleomorph) or/and asexual morph (anamorph) under the microscope.

Species distributions in Fennoscandia were checked using the following sources; for Norway: Artskart (2017), The Norwegian Mycological Database, NMD (2017), and Aarnæs (2002); Sweden: Eriksson (2014) and Artportalen (2017); Denmark: Atlas of Danish Fungi (2017), many old records and records held at Herb. C are yet to be incorporated in the database), and Checklist of Danish Fungi (2017) Finland: Finnish Biodiversity Info Facility (2017).

Collectors and identifiers: BN = Björn Nordén, HV = Hermann Voglmayr, JBJ = John Bjarne Jordal, JF = Jacques Fournier, MJ = Mari Jäntti, PFC = Paul F. Cannon, TL = Thomas Læssøe, WJ = Walter Jaklitsch. The nomenclature follows Eriksson (2014) for species occurring in Sweden, and otherwise Index Fungorum (2017). The reported material will be deposited in Herb. O.

RESULTS

***Antealophiotrema brunneosporum* (Ying Zhang, J. Fourn. & K.D. Hyde) A. Hashim. & Kaz. Tanaka**

The species is new to Fennoscandia. It is previously known from wood of *Salix* spp. It has reddish-brown ascospores, which distinguishes it from similar species.

Material: Møre og Romsdal, Volda, Vassendskreda, UTM32 361918/6877994, on bark of old, pollarded *Ulmus glabra* in a deciduous forest, June 11 2012, leg. JBJ and Perry Larsen, det. TL.

Botryosphaeria corticola **Phillips, A. Alves & J. Luque**

The species is new to Norway. It is associated with dieback and canker diseases of oak, mainly in the western Mediterranean area of Europe but more rarely in other regions (Alves et al. 2004).

Material: Vestfold, Tønsberg, Berg fengsel, UTM32 579404/ 6574211, September 7, 2012, leg. & det. BN. Identified by BLASTing ITS sequences from cultures obtained from wood samples from old oak trees. It had 99% match with Genbank nr AJ293881, which refers to an isolate of the asexual stage *Diplodia mutila* on *Quercus*. In Artskart (2017) listed as *B. stevenssii*, but Alves et al. (2004) reported that isolates from oak differed from *B. stevensii* in morphology and ITS sequence data and described the new species *B. corticola* for the species on oak. The two species are difficult to separate based on the sexual stage.

Capronia munkii **Unter.**

C. munkii is new to Norway and Fennoscandia. It occurs on dead wood, where it may be mycoparasitic. Ascomata of *Capronia* are very small and are usually found as a by-catch in other collections. This species is characterized by ascospores with 4–5 transverse septa.

Material: Telemark, Tokke, Dalen, UTM32 443676/ 6589237, on bark of pollarded *Ulmus glabra* in a deciduous forest, October 2, 2011, leg. JBJ, det. BN. Sogn og Fjordane, Førde, Kusslia, UTM32 337842/ 6815538, on bark of an old, pollarded *Ulmus glabra* in a wooded pasture, June 13, 2012, leg. BN, JBJ, det. BN, TL. Aust-Agder, Bygland, Vormevik, UTM32 428381/ 6520600, on bark of old *Ulmus glabra* in a deciduous forest, May 22, 2014, leg. & det. BN & JBJ.

Capronia normandinae **R. Sant. & D. Hawksw.** Fig. 3 and 6

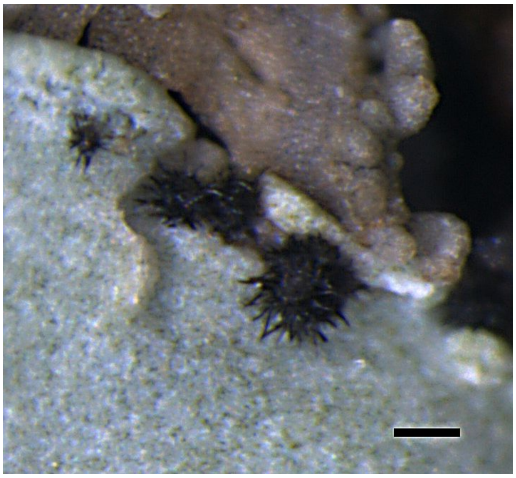

Figure 3. *Capronia normandinae* ascomata on the thallus of the lichen *Normandina pulchella* (scale bar = 100 µm). Photo: T. Rämä, 2015.

This species is also new to Norway and Fennoscandia and is a lichen parasite restricted to the thallus of the lichenized fungus *Normandina pulchella*, which makes it easy to recognize.

Material: Hordaland, Kvinnherad, Alsåker aust, UTM32 335268/ 6628824, on *Normandina pulchella* on an old, pollarded *Fraxinus excelsior* trunk in a wooded pasture, October 2, 2013, leg. BN & JBJ, det. BN.

Capronia parasitica **(Ellis & Everh.) E. Müll., Petrini, P.J. Fisher, Samuels & Rossman**

C. parasitica is new to Norway, has single records from all Fennoscandian countries, and occurs on dead wood where it is probably a mycoparasite. The ascospores are muriform and tapering, with acute ends.

Material: Vest-Agder, Kristiansand, Nedre Timenes, UTM32 447613/ 6447410, on dead *Tilia cordata* wood, October 5, 2014, leg. & det. PFC.

Capronia spinifera **(Ellis & Everh.) E. Müll., Petrini, P.J. Fisher, Samuels & Rossman**
This species is new to Norway and was found once in Sweden. It occurs on dead wood, bark and basidiomata, and is probably a mycoparasite. It has four-celled ascospores measuring 13–15.5 × 3.5–4.5 µm.

Material: Hordaland, Etne, Bjelland, UTM32 342928/6634498, on deciduous bark in deciduous forest, May 10, 2013, leg. & det. BN, TL.

Didymosphaeria massarioides **Sacc. & Brunaud.** Fig. 4
This species was previously reported from northern Norway (Artskart 2017) and Sweden (Eriksson 2014) in Fennoscandia. It has small, inconspicous ascomata, can occur on many different substrates, and have brown, two-celled spores with ridges. An asexual stage has not previously been reported for this species, but we found an asexual stage in close association with the ascomata, born in pycnidia resembling the ascomata. The conidial stage was *Phoma*-like, and the conidia oblong-ellipsoid, 2.0-2.7 x 1.1-1.4 µm.

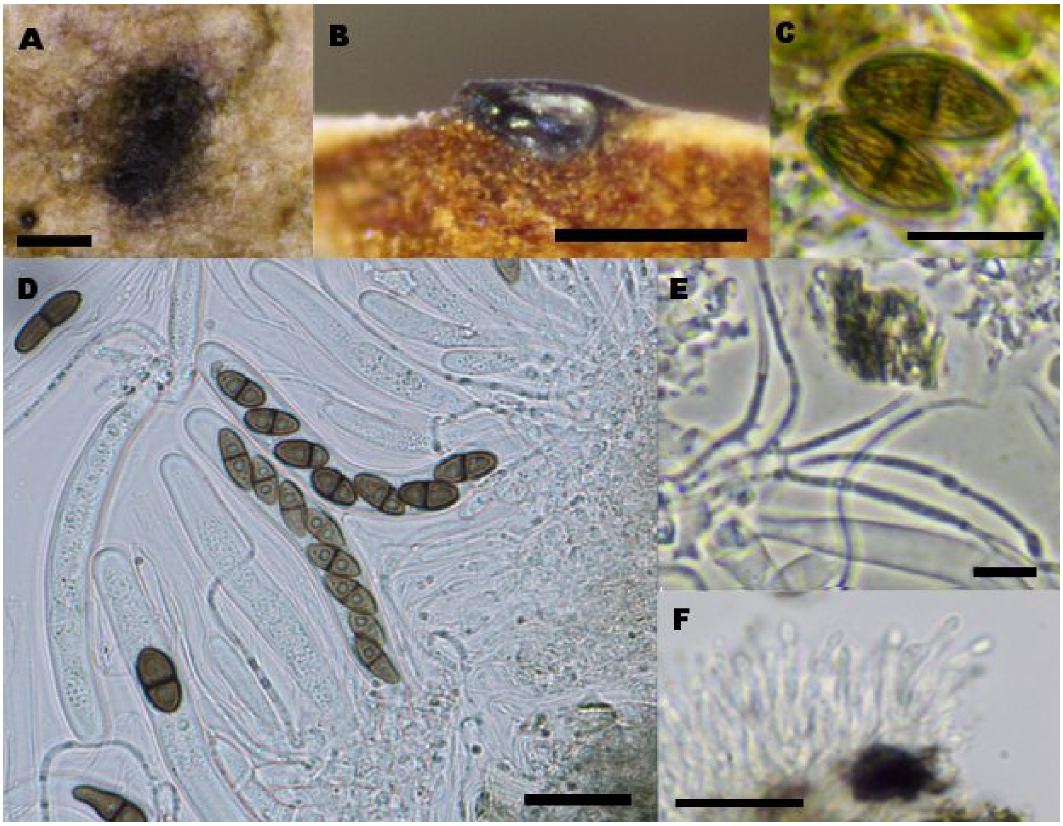

Figure 4. *Didymosphaeria massarioides.* A) Ascomata from above (scale bar = 100 µm), and B) in cross-section (scale bar = 200 µm), and C) spores showing the striate ornamentation (scale bar = 10 µm). D) Hymenium with asci and spores (scale bar = 20 µm). E) Branching filaments (scale bar = 10 µm), and F) conidia (scale bar = 10 µm). Photos: M. Jäntti, 2017.

Material: Vestfold, Tønsberg, Gullkronene naturreservat, UTM32 578486/ 6572761, on *Humulus lupulus*, October 25, 2013, leg. BN, det. BN, MJ. Akershus, Enebakk, Omberg, UTM32 622756/ 6632607, on bark of living *Fraxinus excelsior* (diameter 23 cm), June 14, 2016, leg. MJ, det. BN, MJ, with pycnidia. Østfold, Råde, Tasken, UTM32 599838/ 6579360, on bark of living *Fraxinus excelsior* (diameter 42 cm) bark, June 16, 2016, leg. MJ, det. BN, MJ, with pycnidia.

***Exosporiella fungorum* (Fr.) P. Karst. (*Anomalemma epochnii* (Berk. & Broome) Sivan)**

This species is new to Norway and was previously reported from Denmark. It occurs as a parasite on various corticioid fungi where it forms extensive black powdery patches of conidiospores.

Material: Akershus, Fet, Fetsund, ravine, UTM 32 620756/6645775, parasitic on *Cylindrobasidium evolvens* on deciduous wood in forested ravine, asexual morph, May 6 2013, leg. & det. TL.

***Helminthosporium oligosporum* (Corda) Hughes**

This species, also known as *Corynespora olivacea*, is new to Norway, but was previously reported from Sweden and Denmark. It occurs on dead, still attached or recently shed corticated *Tilia* branches. Whereas the conidiomata are conspicuous forming on grey-black pustules, the ascomata are embedded in the bark and are commonly overlooked.

Material: Aust-Agder, Arendal, Langevoll, Nedenes, UTM32 482424/ 6475690, on *Tilia cordata*, October 4, 2014, leg. & det. HV, WJ.

***Jahnula aquatica* (Kirschst.) Kirschst.**

This species has previously been reported from Denmark and Sweden, but this record is the first from Norway. It grows on submerged wood in freshwater streams. The ascospores are 1-septate, the apices sometimes slightly attenuated, 33-36 × 14-16.5 µm.

Material: Aust-Agder, Arendal, Songeskogen, Stea, UTM32 488539/ 6483502, on coniferous wood in a small stream, October 4, 2014, leg. & det. JF.

***Lophiostoma fuckelii* Sacc.**

Syn. *Vaginatispora fuckelii* (Sacc.) Thambugala, Wanasinghe, Kaz. Tanaka & K.D. Hyde. The species is new to Norway, but was previously reported from Sweden. It occurs on wood, *Rubus* stems and herbaceous stems. The ascospores are hyaline or sometimes slightly coloured when old, 1-septate, 11-18 × 3-5 µm.

Material: Hordaland, Etne, Bjelland, UTM32 342928/ 6634498, on deciduous wood in deciduous forest, May 10, 2013, leg. & det. TL.

***Lophiostoma rugulosum* Y. Zhang, J. Fourn. & K.D. Hyde**

This species is new to Norway and Fennoscandia. The species has mainly been reported from submerged deciduous wood in freshwater streams (Zhang et al. 2009), but is here reported from bark of a tree in a terrestrial habitat, albeit in a strongly oceanic area. The species is characterized by broad umbilicate ostioles rather than apical slits, which is typical for the genus.

Material: Hordaland, Etne, Bjelland, UTM32 343235/ 6634952, on an old, pollarded *Fraxinus excelsior* in a wooded pasture, May 10, 2013, leg. & det. BN, JBJ, conf. TL.

***Massaria macra* (Vestergr.) Voglmayr & Jaklitsch**

This species is new to Norway but was previously reported from Sweden. It occurs on corticated dead branches of *Acer campestre* and *A. platanoides*. It produces a distinctive bright yellow color in the wood, and the 3-septate ascospores are hyaline within the ascus, becoming dark brown after ejection.

Material: Aust-Agder, Arendal, Langevoll, Nedenes, UTM32 482293/ 6475613, on *Acer platanoides* wood in a deciduous forest, October 4, 2014, leg. & det. HV.

Massaria platanoidea **Voglmayr & Jaklitsch.** Fig. 5

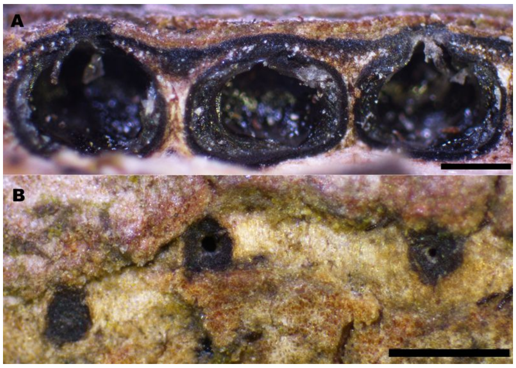

Figure 5. *Massaria platanoidea* ascomata. A) A cross-section and B) ascomata from above (scale bars = 500 μm). Photos: M. Jäntti, 2017.

This species is new to Norway and Fennoscandia. It occurs on corticated dead branches of *Acer campestre* and *A. platanoides*. The ascospores are dark to blackish brown in the ascus.

Material: Aust-Agder, Arendal, Langevoll, Nedenes, UTM32 482293/ 6475613, on *Acer platanoides* wood in a deciduous forest, October 4, 2014, leg. HV, WJ, det. HV.

Massarina rubi **(Fuckel) Sacc.**

This species is new to Norway but was previously reported from Sweden. It occurs on wood of various deciduous trees and bushes. The ascospores are broadly fusiform, hyaline, with upper cell slightly enlarged, 1-septate when young, becoming 3-septate at maturity, 16–22 × 4–5.5 µm, and has bipolar appendages up to 2 µm long.

Material: Aust-Agder, Froland, Ytre Lauvrak, UTM32 462336/6494822, on a dead *Rosa canina* stem in forest, October 3, 2014, leg. & det. PFC.

Moristroma quercinum **Nordén**

This species is new to Norway and is previously known also from Sweden and Denmark. It is rather common on hard heartwood on oak branches, both still attached and fallen. Easily identified by its ecology, small clustered ascomata seated on a basal stroma, and polysporous asci.

Material: Vestfold, Larvik, Vemansås nature reserve, UTM32 554479/ 6555655, on an old *Quercus robur* branch in a deciduous forest, September 22, 2013, leg. & det. BN. Vestfold, Tønsberg, Berg fengsel, UTM32 579404/ 6574211, on an old *Quercus robur* log in a *Quercus* pasture, October 25, 2013, leg. & det. BN. Kragerø, Jomfruland, UTM32 534945/ 6526662, on a dead *Quercus robur* branch, October 6, 2017, leg. & det. BN.

Navicella elegans **Fabre**

This species is new to Norway and Fennoscandia. It occurs on bark of various deciduous trees. In Norway it was found on old *Fraxinus excelsior* trees in south-western Norway (Figure 6). The species is macroscopically similar to the more common species *N. pileata*, but has smaller ascospores (25-38 × 7,5–10 µm) and fewer septa as compared to *N. pileata* (ascospores 45-81 with 7-11 septa).

Material: Rogaland, Strand, Vatland, UTM32 325770/ 6555399, on bark on base of pollarded *Fraxinus excelsior* trunk in a deciduous forest, October 2, 2012, leg. BN, JBJ, det. TL, BN, JBJ. Hordaland, Kvinnherad,

Figure 6. Habitat of *Capronia normandinae* and *Navicella elegans* in Alsåker aust (Kvinnherad, Hordaland). The first species was found on the lichen *Normandina pulchella* and the second species was found on the bark, both on old *Fraxinus excelsior* trees. Photo: J. B. Jordal, 2013.

Alsåker aust, UTM32 335131/ 6628811, 335149/ 6628884 and 335268/ 6628815, on bark of three old (unpollarded) *Fraxinus excelsior* in forested seminatural pasture, October 2, 2013, leg. BN, JBJ, det. TL. Rogaland, Suldal, Mokleiv, UTM32 369042/ 6607459, on bark of old *Fraxinus excelsior* in deciduous forest, September 16, 2017, leg & det. JBJ. Aust-Agder, Arendal kommune, Nedenes, Langevoll, UTM32 8241/7569, on bark of an old dead standing *Fraxinus excelsior* in seminatural pasture, October 4, 2014, leg. & det. HV, WJ. Vest-Agder, Kristiansand kommune, Nedre Timenes, UTM 32 4769/4721, on bark of an old *Fraxinus excelsior* in a deciduous forest, October 5, 2014, leg. & det. HV.

***Poetschia buellioides* Körb.**

This species is new to Norway but was previously recorded from Sweden in Fennoscandia. It occurs on deciduous wood and bark. It has apothecia-like ascomata, subglobose asci, and dark brown two-celled ascospores.

Material: Hordaland, Odda, Buer aust, UTM 32 359568/6659228, on the bark of an old (unpollarded) *Ulmus glabra* tree in deciduous forest, October 3, 2013 leg. BN, JBJ, det. TL.

***Splanchnonema pupula* (Fr.) Kuntze**

This species is new to Norway but was previously recorded from Sweden. It occurs in the bark of still attached or recently shed dead branches of *Acer pseudoplatanus* and has distinctly asymmetric ascospores, 40-50 × 12-18 µm.

Material: Aust-Agder, Arendal, Langevoll, Nedenes, UTM32 8241/7569, on *Acer pseudoplatanus* in an *Ulmus-*/ *Tilia*-forest, October 4, 2014, leg. & det. HV.

Splanchospora ampullacea **(Pers.) Lar.N. Vassiljeva.** Fig. 1
This species is new to Norway and Fennoscandia and occurs in the bark of dead *Tilia* branches. It can be recognized by its unusual ascospores with one large and one small cell.

Material: Aust-Agder, Grimstad, Dømmesmoen, UTM32 475225/6468209, on branch of *Tilia platyphyllos* in a park, October 5, 2014, leg. & det. WJ, HV.

Trematosphaeria hydrela **(Rehm) Sacc.**
The species is new to Norway, but was previously reported from Sweden and Finland. It occurs on deciduous wood, often submerged. The species has large fusiform ascospores, 80-88 × 15-16,5 µm.

Material: Hordaland, Etne, Frettstranda, UTM32 340277/6623487, on dead wood of old (unpollarded) *Fraxinus excelsior* in deciduous forest, May 08, 2013, leg. & det. BN, JBJ, conf. TL. Hordaland, Kvam, Strandadalen, UTM32 333188/ 6690228, on dead wood of an old, pollarded *Ulmus glabra* in a deciduous forest, May 25, 2013, leg. JBJ, det. TL, BN.

DISCUSSION

There is an urgent need for more knowledge on the bitunicate Ascomycota in Norway, regarding the ecology, distribution and status of previously recorded species and species not yet collected in the country. Without such data it will for instance not be possible to evaluate species for red-listing. Also in comparison to other fungal taxa or guilds, non-lichenized ascomycetes are poorly represented on red-lists. On the Norwegian red-list, only 72 or 2.8% of 2597 known non-lichenized ascomycetes are listed (excluding 1915 lichenized species from the totally 4512 known ascomycetes in Norway according to Elven and Søli (2016)), and only few of the total number of species were evaluated. The corresponding figures for basidiomycetes are 838 red-listed species out of 3800 known species, or 22.1%. There is a considerable discrepancy between these phyla in the proportion of red-listed species and in species evaluated for red-listing, and this situation can only improve by increased field activity by 'ascomycologists'. We hope that this article and especially a new biodiversity mapping project scheduled for 2018-2020 may stimulate an increased interest in these fungi in Norway.

ACKNOWLEDGMENTS

The field- and lab work was financed by the Norwegian Biodiversity Information Centre (Artsdatabanken), projects ‘Pyrenomycetes (Sordariomycetes and similar fungi) in temperate deciduous forests of southern and western Norway’ and ‘Bitunicate ascomycetes on bark and wood of selected hosts in Norway’; both projects lead by Björn Nordén. We are grateful to Jacques Fournier, Paul F. Cannon and André Aptroot for assistance with identification/confirmation of some specimens and to Christopher Reisborg, Teppo Rämä and Jason Karakehian for permission to use photos. The photos by Christopher Reisborg were produced during the work with the Encyclopedia of the Swedish Flora and Fauna at the Swedish University of Agricultural Sciences.

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Three species of Sordariomycetes (Ascomycota: Pezizomycotina) new to Norway

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Norsk tittel: Tre sekksporesopper av klassen Sordariomycetes nye for Norge

Nordén B, Jäntti M, Jordal JB, 2017. Three species of Sordariomycetes (Ascomycota: Pezizomycotina) new to Norway. Agarica 2018 vol. 38: 57-60.

KEYWORDS
Ascomycetes, pyrenomycetes, bark-living, wood-living

NØKKELORD
Sekksporsopp, kjernesopp, barklevende, vedlevende

SAMMENDRAG
Tre sekksporesopper av klassen Sordariomycetes rapporteres som nye for Norge: *Hypoxylon subticinense* på dødt trevirke fra ask (*Fraxinus excelsior*)*, Ophiocordyceps stylophora* på en smellerlarve (Elateridae) og *Paranectria oropensis* på epifytiske laver. Funnene presenteres sammen med den kjente forekomsten i resten av Fennoscandia.

ABSTRACT
Three species from Sordariomycetes (Ascomycota) are reported as new to Norway: *Hypoxylon subticinense* on dead wood of ash (*Fraxinus excelsior*)*, Ophiocordyceps stylophora* on a click beetle larva (Elateridae) and *Paranectria oropensis* on epiphytic lichens. The finds are presented together with the known occurrence in Fennoscandia.

INTRODUCTION

Despite that many species of sordariomycetes (‘pyrenomycetes s. str.’) are conspicuous in the field they often don’t get the attention they deserve by mycologists. They are therefore more poorly known compared to for instance most basidiomycete taxa and lichenized fungi, enabling interesting finds on various substrates. We here report three new species for Norway, one from dead wood of ash (*Fraxinus excelsior*)*,* one restricted to click beetle larvae and one lichen parasite. The finds are presented together with the known occurrence in the other Fennoscandian countries.

MATERIALS AND METHODS

Species distributions in Fennoscandia were checked using the following sources; for Norway: Species Map Service (2017), The Norwegian Mycological Database (2017), and Aarnæs (2002); Sweden: Eriksson (2014) and Artportalen (2017); Denmark: Atlas of Danish Fungi (2017); Finland: Finnish Biodiversity Info Facility (2017); Fennoscandia: Nordin et al. (2017).

Collectors and identifiers: BN = Björn Nordén, JBJ = John Bjarne Jordal, MJ = Mari Jäntti, NO = Norway. The nomenclature follows Eriksson (2014) for species occurring in Sweden, and otherwise Index fungorum (2017).

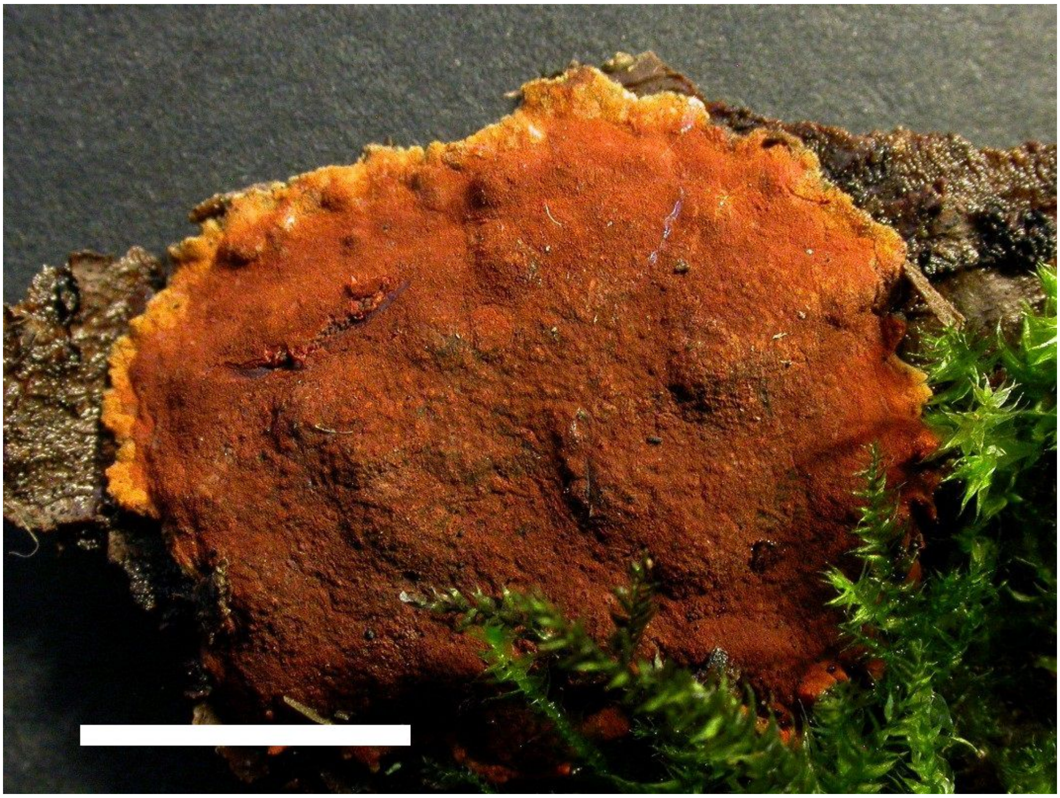

Figure 1. *Hypoxylon subticinense*, from Denmark, showing orange stroma (scale bar = 2 mm). Photo: Jens Maarbjerg, 2016.

RESULTS

Hypoxylon subticinense

Hypoxylon subticinense Y.M. Ju and J.D. Rogers (Figure 1) is previously found in Denmark in Fennoscandia. It occurs on dead wood from deciduous trees. It has distinctive fluffy orange immature stromata and a KOH-reaction similar to that of *H. rubiginosum.* To separate it from *Hypoxylon ticinense* L. Petrini (not found in Fennoscandia) the ascospores need to be examined. Although only immature ascospores were found, they did appear equilateral and we refer the material to *H. subticinense.*

Material: NO Østfold, Moss, Grønliparken, UTM32 590906/ 6589076, on the upper side of log of *Fraxinus excelsior*, diameter 10 cm, in deciduous forest. Growing together with *Protocrea farinosa* and *Skeletocutis nivea,* September 22, 2016, leg. BN, det. BN.

Ophiocordyceps stylophora

Ophiocordyceps stylophora (Berk. & Broome) G.H. Sung, J.M. Sung, Hywel-Jones and Spatafora (Figure 2) is previously known from Sweden in Fennoscandia and is otherwise rare in Europe (Chachuła et al. 2011). It has a greyish stroma with a sterile tip and occurs on larva of click beetles (Elateridae) in dead wood.

Material: NO Vestfold, Sandefjord, Sand, UTM 32 575732/ 6559328, on Elateridae larva in old stump of *Alnus glutinosa* in deciduous forest, October 5, 2016, leg. BN, MJ, det. BN.

Figure 2. *Ophiocordyceps stylophora* stroma showing sterile upper part and papillate ostioles. The stroma was rooted in a click beetle larva concealed in a very much decomposed stump of *Alnus glutinosa* (scale bar = 5 mm). Photo: Mari Jäntti, 2016.

Paranectria oropensis

Paranectria oropensis (Ces. ex Rabenh.) D. Hawksw. and Piroz. (Figure 3) is previously found in Denmark and Sweden in Fennoscandia. It forms a white mycelium and copious orange perithecia and is a parasite on various lichen species.

Material: 6 samples. NO, Rogaland, Strand, Fiskåneset Ø, UTM32 328071/ 6556960, on lichens on bark of pollarded *Fraxinus excelsior* in pasture, October 8, 2012, leg. BN and JBJ, det. BN. NO, Rogaland, Strand, Rag, UTM 32 326098/ 6555365 and 326087/ 6555348, on lichens on bark of old *Fraxinus excelsior* in deciduous forest, October 3 4, 2012, leg. BN and JBJ, det. BN. NO, Hordaland, Osterøy, Kløvneset, UTM32 310658/ 6705250 and 310618/ 6705336, on dead *Physcia* sp. on bark of an old *Fraxinus excelsior* in a deciduous forest, September 30, 2013, leg. and det. BN and JBJ.

DISCUSSION

Most of the species of sordariomycetes reported for the first time in Norway in this paper, and by Nordén et al. (2015), were probably present in Norway for a long time, but has been neglected by mycologists. However, it is also possible that some may be new arrivals resulting from a warming climate. *H. subticinense* may be the most likely candidate since *Hypoxylon* is among the best known genera of sordariomycetes in Norway and since it occurred at a climatically favoured site. Similar establishments would be interesting to follow in the future and more surveys should be performed in the southern parts of Norway.

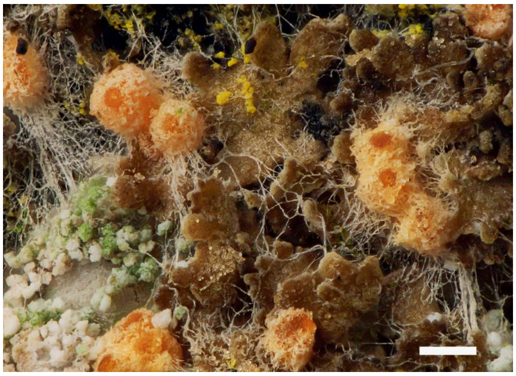

Figure 3. *Paranectria oropensis* ascomata and mycelium overgrowing epiphytic lichens (scale bar = 300 µm). Photo: Cristopher Reisborg, 2012.

ACKNOWLEDGMENTS

The fieldwork was financed by the Norwegian research council project TransForest (number 255043/E50) and 'Pyrenomycetes (Sordariomycetes and similar fungi) in temperate deciduous forests of southern and western

Norway' financed by the Norwegian Biodiversity Information Centre (project ended in 2015). Jens Maarbjerg and Christopher Reisborg kindly provided photos. The photo by C. Reisborg was produced during the work with the Encyclopedia of the Swedish Flora and Fauna at the Swedish University of Agricultural Sciences.

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Aeruginoscyphus sericeus Alb. & Schwein. Dougoud (Ascomycetes, Helotiales, Hyaloscyphaceae) ny for Norden

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English title: *Aeruginoscyphus sericeus* (Alb. & Schwein.) Dougoud (Ascomycetes, Helotiales, Hyaloscyphaceae) new to the Nordic countries.

Olsen O, Røsberg TA, Homble K, 2017. *Aeruginoscyphus sericeus* (Alb. & Schwein.) ny for Norden. Agarica 2017 vol. 38: 61-67.

NØKKELORD
Aeruginoscyphus sericeus, ascomyceter, hule eiker, Buanes, Sogn og Fjordane

KEYWORDS
Aeruginoscyphus sericeus, Ascomycetes, hollow oaks, Buanes, Sogn og Fjordane

ABSTRACT

When searching for hyphomycetes on old oak trees (*Quercus robur* L.) at Buanes, Naustdal Municipality, Sogn og Fjordane County, western Norway, last autumn, some specimen of an ascomycete on greenish wood were collected. Microscopic investigations revealed that its ascospores were different from the ascospores of our two *Chlorociboria* (Seaver ex C.S. Ramamurthi, Korf & L.R. Batra) species, our only species known to be able to make its substrate greenish. Close up pictures of the small apothecia and microscopic pictures and measures were sent to Kåre Homble, who determined the species to be *Aeruginoscyphus sericeus.* The old, and partly hollow, oak trees (diameter 100-180 cm) with the fungus were growing in a southeast facing slope, among smaller oak trees. The apothecia were growing exclusively on naked wood, and they were easy to catch sight of, thanks to their greenish substrate. We concluded that the species has a viable population in the investigated area.

SAMMENDRAG

Under leting etter hyphomyceter på gamle hule eiker ved Buanes i Naustdal kommune i Sogn og Fjordane høsten 2016, ble det samlet noen eksemplarer av en sopp som farget veden grønn. Ved mikroskopering så vi at ascosporene ikke stemte med sporene til noen av de to *Chlorociboria*-artene i Norge som farger veden grønn. Mikroskopibilder og mål ble sendt til Kåre Homble, som bestemte arten til *Aeruginoscyphus sericeus.* De gamle hule eikene vokste i en sørøstvendt skråning, sammen med mindre eiketrær. Fruktlegemene vokste bare på naken ved, og var lett å få øye på takket være den grønne fargen på veden. Vi konkluderte med at arten har en god bestand i området.

INNLEDNING

I forbindelse med leting etter hyphomyceter på gamle sommereiker i Sogn og Fjordane ble det samlet inn noen eksemplarer av en sopp som farget veden grønn. Ved mikroskopering så vi at sporer ikke stemte med noen av de fra før kjente soppene i Norge som farger veden grønn. Bilder av arten med diverse mål ble sendt til Kåre Homble, som bestemte den til *Aeruginoscyphus sericeus* (Alb. & Schwein.) Dougoud. Siden arten ikke er kjent fra Norge og Norden tidligere, beskriver vi funnet og artens totalutbredelse nærmere.

Beskrivelse

Da vi første gang så den grønne fargen, gikk vi helt automatisk ut fra at det var en av de vanlige to artene i Norge som farger veden grønn, *Chlorociboria aeruginascens* (Nyl.) Kanouse eller *C. aeruginosa* (Oeder) Seaver. Men på det grønne oppdaget vi noen grønne geléaktige apothecier med hvite hår. Disse ble samlet inn i den tro at det kanskje var en art som ble misfarget av det grønne fargestoffet til *Chlorociboria*. Soppen er liten: De største fruktlegemene er 2 mm brede. Men på grunn av den grønnfarga veden er den lett å oppdage, om det er noen som vil lete etter den på eik i andre deler av landet.

Aeruginoscyphus sericeus (Alb. & Schwein.) Dougoud

Fruktlegemene ble målt til å være 1,3 mm - 2 mm brede og 0,7 - 1 mm høye. Sporene målte vi til 45-60 x 3-5 µm, og asci ca 120 x 9-13 µm. Celleveggene er diffuse og vanskelige å se. Noen sporer har tre klare septer.

Innsamlet eksemplar

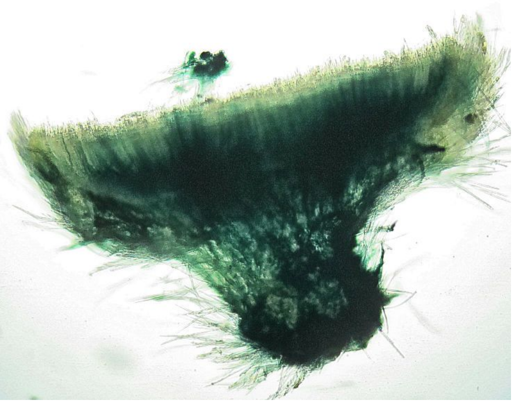
Norge, Sogn og Fjordane, Naustdal, Buanes, 32VLP2015420106, 80 m.o.h., på bar ved av eik, 25.10.2016. Innsamlingen er sendt til NTNU NorBOL i Trondheim for strekkoding.

Økologi

Fruktlegemene til *A. sericeus* i Buanes ble funnet i en sørøst-vendt skråning med både unge og gamle eiker, de gamle delvis hule. De største hule eikene der er 300 – 560 cm i omkrets i brysthøyde. Fruktlegemer kunne ses

Tørr Våt

Figur 1. De største fruktlegemene var 2 mm brede og har silkehvite hår der det grønne skinner gjennom. Alle fotografier gjennom stereolupe og mikroskop.
The largest fruitbodies were 2 mm broad and had silky hairs were the green colour can be seen, All photos are performed using a microscope. Photos: O. Olsen.



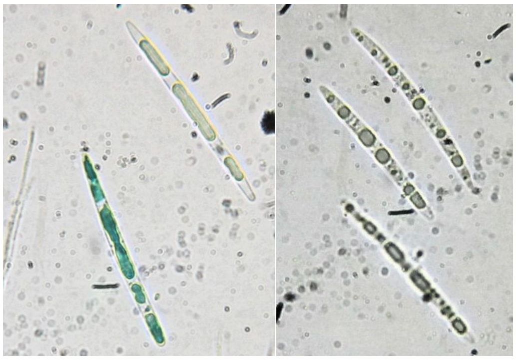
Figur 2. I tverrsnitt ser en at hårene er jevnt fordelt fra basis og helt opp. Dette fruktlegemet er 1,3 mm bredt og 0,7 mm høgt.
In cross section we can see that hears cover the fruit body from the base to the top. This fruitbody is 1.3mm broad and 0.7mm high. Photo: O. Olsen.

både på stående hul eik og på grove greiner på bakken, alltid på bar ved uten bark, og veden var hard selv om den var råtnende. Den grønne fargen ble sett på flere eiker og vi antar at arten her har en god forekomst. Men der er ikke så mange vertstrær: Vi så bare åtte hule eiker i området.

Ingen andre arter vokste tett sammen med *A. sericeus*, dvs. direkte på den grønne veden, men ellers ble flere interessante arter samlet på de gamle, hule eikene. Blant disse var myxomycetene *Licea minima* Fr., *Trichia verrucosa* Berk. og cf. *Diderma deplanatum* Fr. (det. Edvin W. Johannesen 2016).

Taksonomi

Aeruginoscyphus sericeus ble ført til egen slekt i 2011 (Dougoud), etter tidligere å ha vært oppfattet som egen art, *Erinella aeruginosa*, beskrevet av Hennings (1905), og forskjellig fra *Erinella sericea* (Alb. & Schwein.) Quél. (Quélet 1886, p. 301). Slektsnavnet *Erinella* er fra 1879 (Quélet 1879, p. 291).



Figur 3. Til og med noen av sporene hadde grønn farge i seg.
Even some of the spores were colored green. Photo: Oddvar Olsen.

Utbredelse og økologi

Arten er påvist i Europa og Georgia, og de fleste funnene er oppgitt å være på bar ved av gammel eik *Quercus*, men også bøk *Fagus*, og hassel *Corylus avellana* (i Pyrenéene) er oppgitt som substrat. GBIF opplyser om 7 funn (Frankrike, Polen, Spania, Russland, Tyskland(3)). Resten av de oppgitte funnene nedenfor er oppdaget ved søk på Google.

Belgia: 1 lokalitet (Koninklijke Vlaamse Mycologische Vereniging (2017): Namur.)

Bosnia-Hercegovina: 1 lokalitet (Omerović (2014): Olovo, 03.07.2014, *Quercus* (?).)

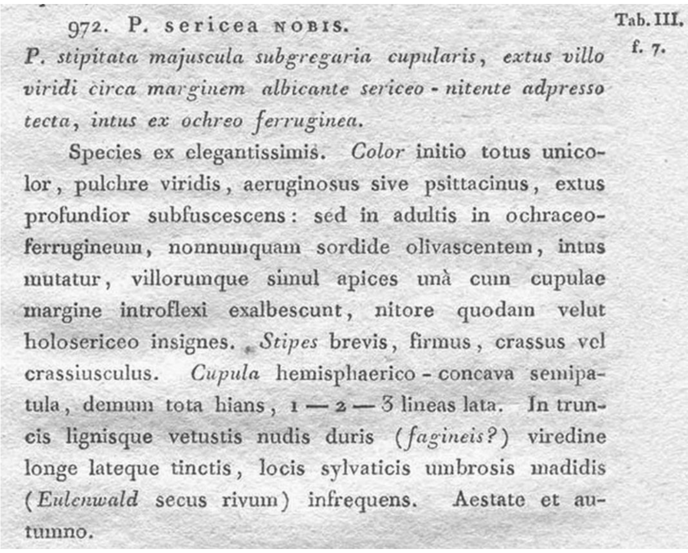
Frankrike: 7 (?) lokaliteter (Lorton 1914 (fra Popov 2013); Röllin and Anthoine 1988 (fra Popov 2013); GBIF: Korsika, 15.06.1990; Dougoud 2012: Ardennes, 07.06.2000, *Quercus*; Van Vooren 2006: Doubs, 09.06.2005; Castillio 2015 a: St. Firmin, 24.05.2012, *Fagus/Quercus*; Domínguez 2016: Lourdes (Pyrenéene), 09.10.2016, *Corylus avellana*.)

Georgia: 1 (?) lokalitet (Nakhutsrizhvili 1986 (fra Popov 2013).)

Figur 4. En av de gamle hule eikene som arten vokste på.
Here is one of the old hollow oaks with fruitbodies. Photo: T.-A. Røsberg.

«Lusatia»: (landskap som omfatter litt av det nåværende Tyskland og Polen på nordsida av Tsjekkia) 1 lokalitet (von Albertini og von Schweinitz 1805, *Fagus* (?).)

Nederland: 9 (7?) lokaliteter (NMV Verspreidingsatlas Paddenstoelen, 7 lokaliteter fra før 1990: Ligterink 1989 (fra Popov 2013), Nauta 1989 (fra Popov 2013).)



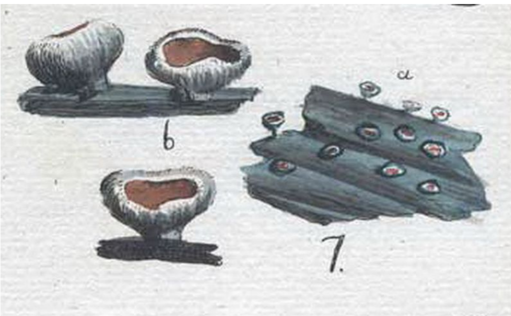
972. P. sericea NOBIS. Tab. III. f. 7.

P. stipitata majuscula subgregaria cupularis, extus villo viridi circa marginem albicante sericeo-nitente adpresso tecta, intus ex ochreo ferruginea.

Species ex elegantissimis. *Color* initio totus unicolor, pulchre viridis, aeruginosus sive psittacinus, extus profundior subfuscescens: sed in adultis in ochraceo-ferrugineum, nonnumquam sordide olivascentem, intus mutatur, villorumque simul apices unà cum cupulae margine introflexi exalbescunt, nitore quodam velut holosericeo insignes. *Stipes* brevis, firmus, crassus vel crassiusculus. *Cupula* hemisphaerico-concava semipatula, demum tota hians, 1 — 2 — 3 lineas lata. In truncis lignisque vetustis nudis duris (*fagineis?*) viredine longe lateque tinctis, locis sylvaticis umbrosis madidis (*Eulenwald* secus rivum) infrequens. Aestate et autumno.

Norge: 1 lokalitet (Naustvik, Sogn og Fjordane, 25.10.2016, *Quercus robur*.)

Polen: flere enn 10 lokaliteter, hvorav de fleste i Białowieża Forest (Dixon 1974: Augustow, 03.09.1966; GBIF: Białowieża Forest, 14.10. 1984; Bujakiewicz et al. 1992: Białowieża National Park; Chmiel 1997: Białowieża National Park; Karasiński et al. 2009: Białowieża Forest (utenfor nasjonalparken), 13.09. 2005; Karaisiński et al. 2010 (fra Szczepkowski et al 2015): Białowieża National Park; Gierczyk et al 2015: Białowieża Primeval Forest, 01.07.2015-17.09.2015 (5 funn); Karaisiński et al. 2015 og Szcsepkowski et al 2015: Kampinoski National Park.)



Figur 5. Originalbeskrivelsen og originalillustrasjonen av *Aeruginoscyphus sericeus* (*Peziza sericea*) i I. B. de Albertini et L. D. de Schweiniz. 1805. *Conspectus fungorum in Lusatiae superioris agro Niskiensi crescentium. E methodo Persooniana,* p. 325 et tab. III, figure 7. *Original description and illustration of Aeruginoscyphus sericeus.*

Russland: 3 lokaliteter (Hennings 1905: Gouv. Moskau, 1904, *Quercus robur*; Popov 2013: Moskva, Sokol'niki, 08. 1920, *Quercus robur*; Popov 2013: Bryanskaya obl., 24.10. 2012, *Quercus robur*.)

Spania: 2 lokaliteter (GBIF: Bergua, Huescu, *Corylus avellana*; Castillo 2015b: Huescu, 24.08.2015, *Corylus avellana*.)

Sveits: 3 lokaliteter (Dixon 1974: Genève, 1967; Dougoud 2012: Fribourg, 16.07.2011, 30.07.2011, *Quercus*; Mykologische Gesellschaft Luzern (2017): Waldreservat Gitzitobel, 11.08.2012, *Fagus*.)

Tyskland: 7 lokaliteter (Deutsche Gesellschaft für Mykologie (2017), Datenbank: Bayern (4), Baden-Württemberg (1), Saarland (1), Nordrhein-Westfalen (1), *Fagus* og *Quercus robur*.)

TAKK

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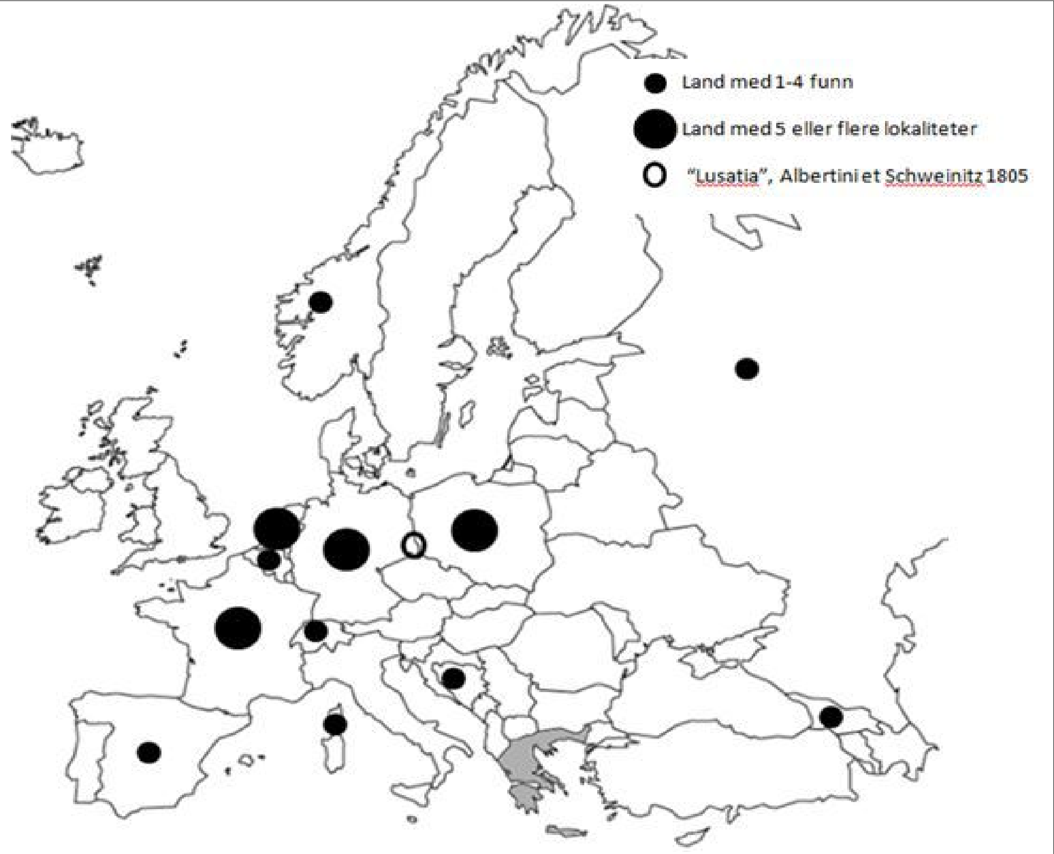

Figur 6. Kjent utbredelse til *Aeruginoscyphus sericeus* fram til 23.01.2017.
Known distribution of Aeruginoscyphus sericeus *until 23.01.2017.*

Doktorgrad/Dr. philos. thesis

Virkningen av mikroklima på biologisk nedbrytning av treverk i historiske bygninger

(The impact of microclimate on biodeterioration of wood in historic buildings)

Johan Mattsson Dr. philos.-avhandling på
NTNU, 2017:13
Mycoteam AS, Postboks 5 Blindern, 0313 Oslo

Avhandlingen består av en sammenstilling på 188 sider samt 8 vitenskapelige artikler. Hvis du ønsker en kopi av avhandlingen kontakt Dr. Johan Mattsson, johan@mycoteam.no

Bygningsmaterialer i historiske bygninger kan gjennom en langvarig eksponering for ulike klimatiske og mikroklimatiske forhold utsettes for en gradvis nedbrytning av biologiske skadegjørere. Denne studien viser at avgjørende faktorer i forskjellige tilfeller av biologisk nedbrytning i stor grad er temperatur og fuktighet på et mikroklimatisk nivå, helt ned til noen få centimeter rundt vedcellene i treverket.

Ved bygningsundersøkelser av historiske bygninger kan man ønske seg en god tilgang til historisk informasjon om konstruksjoner, materialer, tidligere bruk, eksponering og eventuelle skader. Dessverre er slik informasjon sjelden tilgjengelig. Fordi både muggsopp, råtesopp og treskadeinsekter har spesielle krav til økologiske forhold, er etablerte skader et

Innvendige råteskader i tømmer med jordkontakt på Svalbard.
Internal fungal deterioration in wooden pole with soil contact at Svalbard. Photo: Mycoteam.

Råteskader i soleksponert del av tømmerrenne på Røros.
Fungal deteriorated wood in sunexposed part of wooden flume at Røros. Photo: Mycoteam.

resultat av tidligere langtidseksponering av fukt- og temperaturforhold. Identifikasjon av forekommende arter kan dermed gi avgjørende innsikt om skader. Hvis man kan tolke skadene i henhold til disse forholdene, kan man forstå årsakene til skadeutvikling og dermed også forebygge ytterligere skadeutvikling. Min erfaring er at forutsetningen for biologisk nedbrytning av treverk er universell. Takket være dette kan man i prinsippet vurdere skader fra polområdene til tropene på den samme måten.

De mikroklimatiske forholdene og aktivitet av ulike biologiske skadegjørere har vært undersøkt på fire ulike steder i Norge: Bryggen i Bergen, Lærdalsøyri/Otternes, Røros og Svalbard i forbindelse med ulike prosjekter i løpet av en 20 års periode. Målet med disse studiene har vært å avklare hvordan mikroklimaet påvirker sopp- og insektskader i verneverdige bygninger og trekonstruksjoner – både med hensyn til de faktiske skader og de praktiske konsekvenser skader forårsaker. Fokus har vært på de to mest avgjørende fysiske faktorene for biologiske skadegjørere, temperatur og fuktighet.

På Bryggen i Bergen er fuktighet og temperatur gunstig for både vekst av sopp og aktivitet av treskadeinsekter. Til tross for dette, har treverket i fundamentene under bygningene på Bryggen overraskende få skader. Grunnen til dette er en langvarig akkumulasjon av salt i treoverflatene fra sjøvann og søl fra bruk og lagring. Dette har gitt en lokal, effektiv beskyttelse av treverket mot biologisk nedbryting.

Husbukk (*Hylotrupes bajulus*) har gode utviklingsmuligheter i den indre delen av Sognefjorden på Vestlandet i Norge. Bygningsundersøkelser og oppfølging av ulike konstruksjoner i den gamle trehusbebyggelsen i Lærdalsøyri og bygdetunet Otternes har vist hvor stor innvirkning temperatursvingninger har for å forebygge insektskader. Undersøkelsene har også vist hvor viktig det er at man formidler måleverdiene på en korrekt måte for at de skal gjenspeile den aktuelle situasjonen.

Historiske bygninger og konstruksjoner på Røros består av tettvokst furu med stor kjernevedsandel og de står i et kaldt og tørt klima. Dette gir en generelt god beskyttelse mot biologisk nedbrytning, men undersøkelser har vist at selv små variasjoner i temperatur er avgjørende for utvikling av råtesoppskader. Utendørs eksponert treverk på Røros har vist seg å ha en vedvarende høy fuktkvote. Dette innebærer en klar risiko for utvikling av råtesoppskader, men takket være det kjølige klimaet har materialene en forventet lang levetid. Imidlertid har studien vist at tre med en solutsatt posisjon kan ha lokalt omfattende råtesoppskader, hovedsakelig forårsaket av vedmusling (*Gloeophyllum sepiarium*), men også til dels av rottåre (*Ditiola radicata*) og tåresopp (*Dacrymyces stillatus*). Disse skadene er avgrensede til den solutsatte delen av materialet, mens deler i permanent skygge er uten skader.

Det arktiske klimaet på Svalbard har tradisjonelt vært ansett for å gi en god beskyttelse mot biologisk nedbrytning. Til tross for det ekstremt kalde og tørre klimaet har undersøkelser vist at det er et stort problem med råtesoppskader i de fredede bygningene og konstruksjonene. På grunn av lokalt gunstig mikroklima i solutsatte deler av treverket, særlig i jordkontakt, kan råtesopp forårsake alvorlig skader i løpet av relativt kort tid. På Svalbard er det en spesiell art av råtesopp, husnettsopp (*Leucogyrophana mollis)*, som dominerer kraftig i skadene, mens det kun er enkelte observasjoner av arter som rekkekjuke (*Antrodia serialis*) og kjellersopp (*Coniophora puteana*). Dette er klart annerledes enn hva som er observert ved råtesoppskader i bygninger i Norge for øvrig.

Kombinasjonen av at sopp- og insektskader hovedsakelig utvikles inne i trematerialene og at det eksisterer klare tekniske begrensninger i mulighetene for å grundig undersøke historiske bygninger, fører til at det er vanskelig å gjennomføre en tilfredsstillende avklaring og vurdering av eventuelle skader. Med en utilstrekkelig forståelse av skaden, blir både vurderinger og tiltak unøyaktige, og i noen tilfeller feil. Konsekvensen av dette kan være både unødvendige tiltak og utgifter. Det er også en klar risiko for videreutvikling av biologisk nedbryting av treverket. Dette betyr at man må sørge for at de som gjennomfører undersøkelser og vurdering av sopp- og insektskader har en tilstrekkelig god kunnskap til å utføre dette arbeidet.

Denne avhandlingen beskriver hvordan mikroklimaet påvirker biologisk nedbrytning av treverk i historiske bygninger. Det er en forhåpning om at disse resultatene og erfaringene bidrar til å forbedre denne kunnskapen i ulike fagmiljøer.

Mastergrad NMBU

Råte i gran på Nord-Vestlandet

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Masteroppgave (30 studiepoeng) ved NMBU
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Gran vokser ikke naturlig på Vestlandet, men er blitt plantet ut i nyere tid. *Heterobasidion parviporum* (granrotkjuke) er den største skadegjøreren av råtesopper i det naturlige utbredelsesområde for gran i Norge, men dens opptreden utenfor dette området er lite kjent. På Vestlandet opptrer imidlertid *H. annosum* (fururotkjuke) som også kan gå på gran*,* men dens opptreden og utbredelse nordover er lite kjent. Det nordligste kjente funnet i Norge har vært i Molde kommune, Romsdal. Utgangspunktet for oppgaven var å se om råte forårsaket av *Heterobasidion* spp. og andre råtesopper er et utbredt problem på Nord-Vestlandet. Stormers effekt på råtefrekvensen ble også undersøkt.

Stubber av gran på hogstfelt ble undersøkt for råteskader i kommunene Ørsta, Sunndal og Halsa i Møre og Romsdal og Hemne i Sør-Trøndelag. Fra de fleste råteflekkene på stubber som kunne relateres til innråte ble sopper isolert. Soppene ble gruppert i morfologiske typer og 2-3 representanter fra hver gruppe ble sekvensert med primerne ITS1F og ITS4. Sekvensene ble sammenlignet med sekvenser i GenBank. Likhet på 98-100 % ble brukt på artsnivå.

To typer hogstfelt ble undersøkt hvor den ene typen hogstfelt ble avvirket etter stormen Dagmar, og det ble gjort undersøkelser i ni felt av denne typen to til tre år etter hogst. I disse prøveflatene hadde det vært råte i 21,7 % av trærne før de ble avvirket (gammel innråte), men det var store forskjeller mellom flatene og fra 0 % til 94,4 % hadde innråte ved hogst. Det var innråte for-

Figur 1. *Sistotrema brinkmannii* er en svært vanlig sopp i skogøkosystemet og fins helst på nedbrutt virke. Den kan imidlertid også infisere levende trær via sår, og kan utvikle en nokså omfattende innråte. Foto: Lars Halvor Bjørbæk.

årsaket av *Heterobasidion* spp. i 8,5 % av stubbene. I 6,9 % av stubbene var det en innråte forårsaket av *Armillaria* spp. (honningsopper). Den andre typen hogstfelt ble avvirket i 2015 grunnet hogstmodenhet, og det ble gjort undersøkelser i fem prøveflater av denne typen. Det var gammel innråte i 17,4 % av stubbene, og det var innråte forårsaket av *Heterobasidion* spp. i 4,1 % av stubbene fra disse flatene. I tillegg ble det funnet to stubber som var blitt infisert med *Heterobasidion* spp. etter hogst. I en stubbe var det *H. annosum* og den andre var det *H. parviporum*. *Armillaria* spp. fantes kun som innråte i disse feltene, og ble funnet i 12,4 % av stubbene.

Heterobasidion annosum ble funnet i Halsa kommune (63.104527N 8.342807E). Dette er den nordligste sikre registreringen av arten i Norge, muligens også i verden. *Heterobasidion parviporum* ble også funnet i Halsa, og dette er første registrerte funn av arten i dette området som ligger utenfor granas naturlige utbredelsesområde. Dette betyr at *H. parviporum* er på vei inn i den planta granskogen på Nord-Vestlandet. *Armillaria* spp. ble funnet i alle kommunene. Det ser ut til at råtefrekvensen for *Heterobasidion* spp. og *Armillaria* spp. var relativt lik i studieområdet.

Cylindrobasidium evolvens (favnvedsopp), *Peniophora* spp. (torneskinn), *Sistotrema brinkmannii* (Figur 1) og *Stereum sanguinolentum* (toppråtesopp) ser også ut å være vanlige innråtesopper i studieområdet. Andre råtesopper som sjeldent opptrer som innråte var *Amylostereum areolatum*, *A. chailletii* (granlærsopp), *Hypholoma capnoides* (svovelsopp), *Mycena rubromarginata* (rødkanthette), *Phlebiopsis gigantea* (stor barksopp) (Figur 2), *Resinicium bicolor* (grynbarksopp), *Stereum rugosum* (skorpelærsopp) og *Trametes versicolor* (silkekjuke).

Undersøkelsen gav ingen entydige svar på om stormer er med på å øke råtefrekvensen.

Figur 2. Stor barksopp (*Phlebiopsis gigantea*) er forholdsvis sjelden som innråtesopp, men kan etablere seg via sårskader. Soppen er også viktig i skogbrukssammenheng da den brukes i bekjempelse av rotkjuke. Foto: Lars Halvor Bjørbæk.

Mastergrad NMBU

Råte i høyereliggende granskog på Østlandet

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Masteroppgave (30 studiepoeng) ved NMBU
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Råte kan være et stort problem i eldre granskoger, og i gjennomsnitt er hvert fjerde grantre i Norge infisert. I den lavereliggende skogen på Østlandet er *Heterobasidion parviporum* (granrotkjuke) kjent som den verste skadegjøreren. I den høyereliggende granskogen er det derimot mer usikkert hvilke råtesopper som er mest vanlig. Hensikten med denne undersøkelsen var å undersøke råte i høyereliggende granskoger på Østlandet.

De undersøkte flatene var fra 550 til 840 meter over havet. På 1575 stubber fordelt på 24 flater ble råte registrert på hogstflater som var avvirket i løpet av de siste to årene. I Vestre Slidre var prøveflatene (1-5) på et gammelt forsøksfelt hvor gran var blitt plantet på en gammel setervoll. Der var det fire flater med forskjellige tynningsintensiteter og en urørt flate, alle av ulik størrelse. Ellers ble det lagt ut prøveflater på 900 m^2 (flate 6-24), på forskjellige steder på Østlandet.

Figur 2. *Hypochnicium albostamineus* er også en sopp som sjeldent forårsaker innråte i trær. I dette tilfellet må den ha vært tilstede over lang tid, siden trevirket er mye nedbrutt. Foto: Lars Halvor Bjørbæk.

Fra de fleste råteflekkene på stubber som kunne relateres til innråte ble sopper isolert. Soppene ble gruppert i morfologiske typer og 2-3 representanter fra hver gruppe ble sekvensert med primerne ITS1F og ITS4. Sekvensene ble sammenlignet med sekvenser i GenBank. Likhet på 98-100 % ble brukt på artsnivå.

På flate 1-5 var i gjennomsnitt 78,1 % av 452 stubber råteinfisert. Den vanligste råtesoppen var *H. parviporum* som ble funnet på 26,5 % av stubbene. På flate 1-5 ble det funnet 23 forskjellige råtesopper, og de vanligste i tillegg til *H. parviporum* var *Armillaria* spp. (honningsopper), *Porodaedalea* sp. (granstokkjuke), *Sistotrema brinkmannii* og *Stereum sanguinolentum* (toppråtesopp).

Heterobasidion parviporum stod for 29,9 % av den totale råten på disse flatene. Studier av somatisk inkompatibilitet viste at hvert individ av *H. parviporum* på disse flatene hadde i snitt infisert 1,2 stubber.

Tynningsinngrepene ser ikke ut til å ha hatt innvirkning på råteutviklingen da det var ingen eller små forskjeller på råteutviklingen med de forskjellige tynningsinngrepene.

På flatene 6-24 var 32,8 % av 1123 undersøkte stubber råteinfiserte. Vanligst på disse flatene var *Armillaria* spp. som ble registrert på 14,4 % av stubbene. Honningsopper ble som oftest bestemt ut fra symptom. I noen tilfeller ble de forsøkt isolert og sekvensert. Både *A. borealis* (skoghonningsopp) og *A. cepistipes* (hagehonningsopp) var tilstede. Det ble funnet 31 forskjellige råtesopper på flate 6-24, og de vanligste i tillegg til *Armillaria* spp. var *S. sanguinolentum*, *S. brinkmannii*, *H. parviporum* og *Climacocystis borealis* (vasskjuke). Kun 7,2 % av den totale råten på flatene 6-24 var forårsaket av *H. parviporum*. På disse flatene hadde hvert individ av *H. parviporum* i snitt infisert 1,7 stubber.

Denne studien viser at *H. parviporum* ikke er like dominerende i høyereliggende skoger på Østlandet som den er i lavlandet, hvor den gjerne er årsak til mellom 60 og 80 % av råten i granskog. At *Armillaria* spp. var vanligst er ikke helt ukjent da den har vist seg å være nokså vanlig i høyereliggende granskoger skoger i tidligere undersøkelser. *Sistotrema brinkmannii* har ikke vært kjent som svært vanlig innråtesopp tidligere, men den var vanlig i begge typer av prøveflater.

Figur 1. *Xylodon asperus* (glisneknorteskinn) er en vanlig sopp på nedbrutt trevirke. I noen tilfeller er den årsak til innråte i gran som bildet viser hvor den har utviklet en omfattende råte. Den har trolig etablert seg i sårskader. Foto: Lars Halvor Bjørbæk.

Mastergrad/Master Thesis UiO

Climate change effects on substrate affinity and trait-dependent responses in wood-decomposing fungi

(Effekten av klimaendringer på substratvalget og karaktertrekkene til vedboende sopp)

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Master Thesis at the Universitetet i Oslo
Avalible via: https://www.duo.uio.no/handle/10852/54575

Climate change is the effect of rapid and recent change in global climate variables, affecting all species in all ecosystems. Fungi are no exception, fulfilling a variety of important roles as decomposers, parasites and mutualists. Polyporoid fungi, the focus of this study, grow on decaying trees as saprotrophs or necrotrophs, where they produce annual or perennial fruit bodies.

This study investigated the substrate ranges of 61 different species of polyporoid fungi, and assessed the effects of climate change on host affinity and fungal traits. The quality of the data was evaluated using descriptive statistics to ensure best results from the analyses. Substrate ranges were correlated with genetic distances between fungal species, demonstrating a relationship between the genetic similarity and host range. The majority of fungal species were growing on a low number of hosts, with the exception of some species with wide host ranges. Ordination methods were used to determine the significant effects of climatic variables. Mean annual temperature, temporal change, regional distribution, and host genera had a significant effect on the data, explaining 44% of the model's total variation.

Lastly, we investigated the influence of traits on fungi's responses. Correlations were seen between preference towards downed ("dead") substrate usage and temporal change. This correlation was closer investigated in a regression analysis, showing that downed substrate usage increased proportionally by 30% more than standing ("living") substrate usage. Mean annual temperature was negatively correlated with spore size in the overall community, but separate host genera revealed individual effects towards spore size, both positive and negative. Rot type and hyphal system was also correlated with different host genera, but did not provide enough information to draw any biological conclusion.

By including a variety of explanatory variables, we can relate them to host affinity and fungal ecology, and improve our understanding on fungal responses to climate change.

Trametes versicolor, an important species in this MSc study. Photo: Klaus Høiland.

Bitunicate ascomycetes: a new biodiversity mapping project for Norway

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ABSTRACT
The state of knowledge in Norway is poor to very poor regarding taxonomy, distribution and ecology of the bitunicate ascomycetes (see pages 47-56 in this vol. of Agarica; *Twenty species of bitunicate ascomycetes new to Norway*). We announce a new biodiversity mapping project on non-lichenized bitunicate ascomycetes on selected substrates in Norway, and invite mycologists to send interesting specimens, especially species with hysterothecia, to us for examination or confirmation.

SAMMENDRAG
De bitunikate sekksporesoppene er en lite studert og svært dårlig kjent soppgruppe i Norge, og det antas at det finnes et betydelig antall uoppdagete arter (Se artikkelen *Twenty species of bitunicate ascomycetes new to Norway*, side 47-56 i dette vol. av Agarica). Et nytt kartleggingsprosjekt om tykksekksopper på bark og ved av bestemte treslag, finansiert av Artsdatabanken, presenteres. I forbindelse med dette prosjektet inviterer vi mykologer til å samle inn og sende oss eksemplarer av interessante arter fra Norge, særlig arter med hysterothecier.

The new biodiversity mapping project

In a new biodiversity mapping project funded by the Norwegian Taxonomy initiative and lead by Bjørn Nordén, we focus on species of Dothideomycetes and Chaetothyriomycetidae on bark and wood of selected tree species. The main aims of the project are mapping of the distribution of known taxa, searching for species new to Norway, and revision of selected taxa in the herbaria.

The project will run from 2018 through 2020. The task of mapping the biodiversity of these groups is enormous, and any sampling strategy needs to be restricted to a few case studies. We plan to sample primarily from the following host tree species: *Ulmus glabra*, *Fraxinus excelsior*, *Quercus* spp., *Populus tremula*, *Corylus avellana*, *Pinus sylvestris* and *Taxus baccata*. We will put special emphasis on substrates on living trees, including smooth bark and still attached but recently dead branches, and the coarse bark and exposed wood of old *P. sylvestris* and *P. tremula*. Some of the selected tree hosts (*Ulmus glabra, Fraxinus excelsior* and *Taxus baccata*) are red-listed and declining, meaning that host specific Ascomycota may also be declining. Sampling will be performed at various locations in Østlandet, Sørlandet, Sunnhordland, Møre og Romsdal and Finnmark.

A request for assistance

We would be happy if other mycologists could assist in the collection of material, and think that a suitable group of fungi could be non-lichenized species with hysterothecia (Figure 2 on page 49 this volume). Contributions from other parts of Norway than covered by our fieldwork could potentially give us a much better picture of the distribution of various species. Collections can be made from wood or bark of various trees in any part of the country. The material should be in good condition, dried at room temperature and contain asci and ascospores.

Determination should be attempted before sending it to us (Björn Nordén). It needs to be annotated with standard data, includinghost and geographic position. A good key to several genera and species can be found in Boehm et al. (2009), available online (doi:10.3114/sim.2009.64.03). We are of course also interested in material of rare, little encountered, and possibly undescribed species of other taxa within the focus group of the project.

We hope that the article presenting 20 bitunicate ascomycetes new for Norway (Nordén et al. 2018) and especially this new biodiversity mapping project scheduled for 2018-2020, will stimulate an increased interest in these fungi in Norway.

The project is lead by Björn Nordén[1] (Bjorn.Norden@nina.no). Mari Jäntti[1], John Bjarne Jordal[2], Thomas Læssøe[3], Hermann Voglmayr[4], Walter Jaklitsch[4,5] are all participants in the project.

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Nordén B, Jäntti M, Jordal JB, Læssøe T, Voglmayr H, Jaklitsch W, 2018. Twenty species of bitunicate ascomycetes new to Norway. Agarica 2018 vol. 38: 47-56.

Popularisert bidrag

Hundreds of species observations and four ascomycetes new to Norway during a mycology field course

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ABSTRACT

During a mycology field course in Drøbak 29th August – 2nd September 2011 several interesting and some new taxa to Norway were found. Species not previously recorded in Norway include *Tatraea dumbirensis*, *Corollospora maritima*, *Nectriopsis candicans* and *Ombrophila juniperinella*. A list of 413 taxa, including records of three threatened species, is given and the ecology and distribution of the rare discomycete *T. dumbirensis* is discussed. Based on the results it can be concluded that basic field courses focusing on species identification in quite poorly known organism groups produce not only future naturalists, but also valuable floristic data. Field courses with competent teachers and tens of motivated students collecting in the field are effective and low-cost means for species mapping, and thus they should be increasingly supported.

SAMMENDRAG

På et feltkurs i mykologi i Drøbak 29. august – 2. september i 2011 ble det funnet flere interessante samt noen nye taxa for Norge. Arter som tidligere ikke hadde vært funnet i Norge er *Tatraea dumbirensis*, *Corollospora maritima*, *Nectriopsis candicans* og *Ombrophila juniperinella*. En liste på 413 taxa, inkludert tre truede arter, er presentert som nettvedlegg og økologien og utbredelsen til den sjeldne discomyceten *T. dumbirensis* er diskutert. Basert på resultatene fra kurset kan det konkluderes med at feltkurs som fokuserer på artsidentifisering av relativt dårlig kjente organismegrupper ikke bare produserer framtidige naturkyndige, men også verdifulle floristiske data. Feltkurs med kompetente lærere og titalls av motiverte studenter er en effektiv og rimelig måte å kartlegge arter og burde støttes i større grad.

BACKGROUND

About 30 persons attended the 5-day field course that used the Drøbak field station in SE Norway (Frogn, Akershus) as a base camp. Each day 1–2 localities were visited, fungi recorded in the field and collected for further identification in the microscope lab of the field station. The focus of the course was on mushrooms (agarics), but also some less conspicuous ascomycetes were collected. Identified fungi were placed in an exhibition where students could study them day and night. Active self-learning was supplemented with demonstrations of the taxonomic characteristics and ecology of collected fungi by professional mycologists.

FINDINGS

Already on the first course day, in the first locality visited, the author collected a new species to Norway. *Tatraea dumbirensis* (Velen.) Svrcek, originally described as *Helotium dumbirense* Velen. from the Tatra mountains in Slovakia (Velenovský 1934). It was found growing on a 2-centimeter thick dead branch of deciduous wood in Smihagen nature reserve, Frogn, Akershus (Figure 1). Two days later another course attendant, Jørn R. Gustad, observed the same species in Røerskogen forest, Nesodden, Akershus. The species is a rare, or supposedly rare, flesh-coloured stipitate discomycete characterized

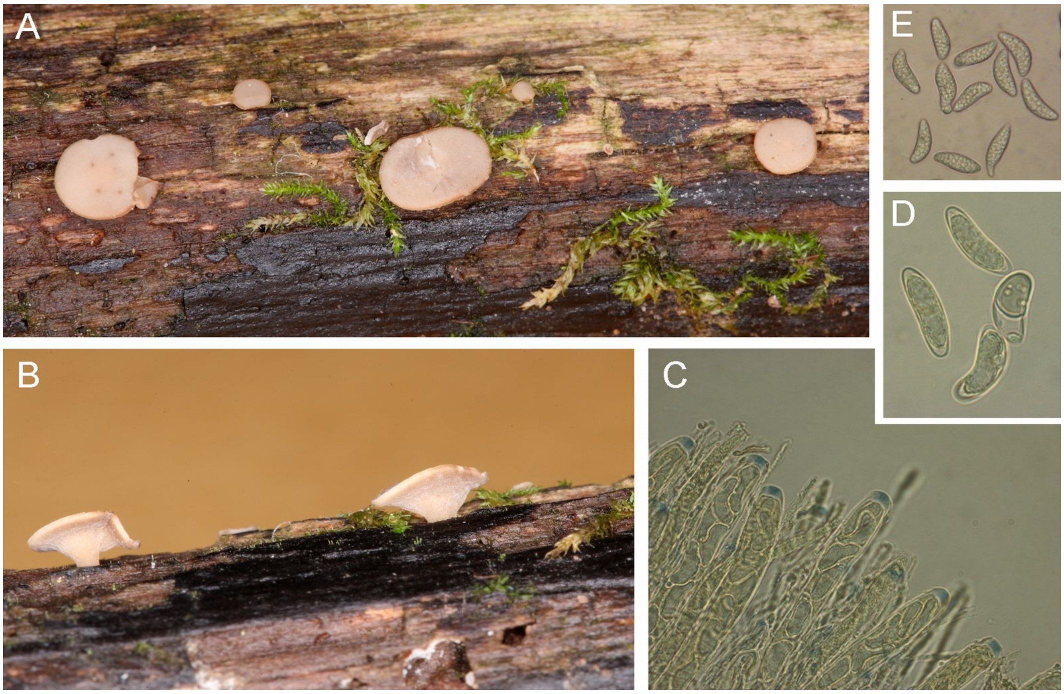

Figure 1. *Tatraea dumbirensis* (TROM-F26042). A–B) Fresh apothecia on decorticated wood. Photos: Jørn R. Gustad, C) Dried herbarium material in light field showing ascus apex turning blue in Lugol's solution. Photo: Teppo Rämä, D) Spores of herbarium material in Lugol's solution. Photo: Teppo Rämä, E) Living spores of another collection of *T. dumbirensis* from *Alnus viridis* wood at 1650 meters altitude (HB 8289: Switzerland, Uri, Glarner Alpen, 46°51'27''N 8°45'30''E, 21.8.2006, leg. R. Mürner) in water. Photo: Hans-Otto Baral. Note that pictures are taken using different scales.

by curved and round-ended ascospores that are densely filled with small oil droplets in the living state, and an ascus apparatus with extensions in the upper part that turn deep blue in Lugol's solution (IKI) (Baral et al. 1999). The species obviously belongs to the fungal order Helotiales (Leotiomycetes), but its phylogenetic placement within the order remains to be verified using molecular systematics. The material collected in Smihagen has been sequenced for the Internal Transcribed Spacer (ITS) region and the result will be made available in the Barcode of Life Data System (Ratnasingham and Hebert 2007).

Tatraea dumbirensis has previously been found on deciduous wood in several European countries including Austria, Denmark, Croatia, France, Germany, Great Britain, Italy, Spain, Slovakia, Sweden and Switzerland (Baral et al. 1999, Jamoni 2005, Eriksson 2011, Holec et al. 2015, Adamčík et al. 2016, Danish mycological society 2017). It seems to prefer *Fagus* as a substrate, but has also been found on other deciduous trees (*Fraxinus*, *Betula*, *Sorbus*) and on *Abies*. Based on published finds, the species occurs predominantly in old-growth forests in mountainous areas. Considering the decline of undisturbed virgin forests in Europe and due to a small or restricted population size, *T. dumbirensis* is considered threatened in the UK and Croatia (Evans et al. 2006, Tkalčec et al. 2008), whereas in the Nordic countries the red list status of the species has not been evaluated.

Other species that were found new to Norway during the course were *Ombrophila juniperinella* (P. Karst.) Boud (syn. *Antinoa juniperinella* (P. Karst.) Velen.), *Nectriopsis candicans* (Plowr.) Maire, and a marine fungus called *Corollospora maritima* Werderm. (Figure 2). The record of *C. maritima* from wood (*Betula* sp.) with attached sand grains in the intertidal zone in Rosnestangen of Jeløya (Moss, Østfold) has been published elsewhere (Rämä et al. 2014). This truly marine ascomycete with delicate spore appendages is a cosmopolitan species with high genetic variation and may be split into several species in the future (Roberts et al. 1996, Velez et al. 2015).

Other rare fungi detected during the course include ascomycetes, e.g. *Sphaerostilbella berkeleyana* (Plowr. & Cooke) Samuels & Cand. and *Strossmayeria basitricha* (Sacc.) Dennis, two species which have been detected only once before in Norway (Artsdatabanken 2017), and further the earth tounge *Microglossum olivaceum sensu lato* (IUCN status Vulnerable) a truffle species *Genea hispidula* Berk. ex Tul. & C. Tul. (Figure 3) and *Trichoderma citrinoviride* Bissett (synonym *Hypocrea schweinitzii* (Fr.) Sacc.) (TROM-F-26045). More seldom observed basidiomycetes include clavarioid species such as *Clavaria zollingeri* Lév. (Vulnerable), *Ramariopsis pulchella* (Boud.) Corner, and agarics such as *Resupinatus applicatus* (Batsch) Gray, a common but overlooked species in Norway, *Dermoloma cuneifolium* (Fr.) Singer ex Bon (Vulnerable), and *Limacella delicata* (Fr.)

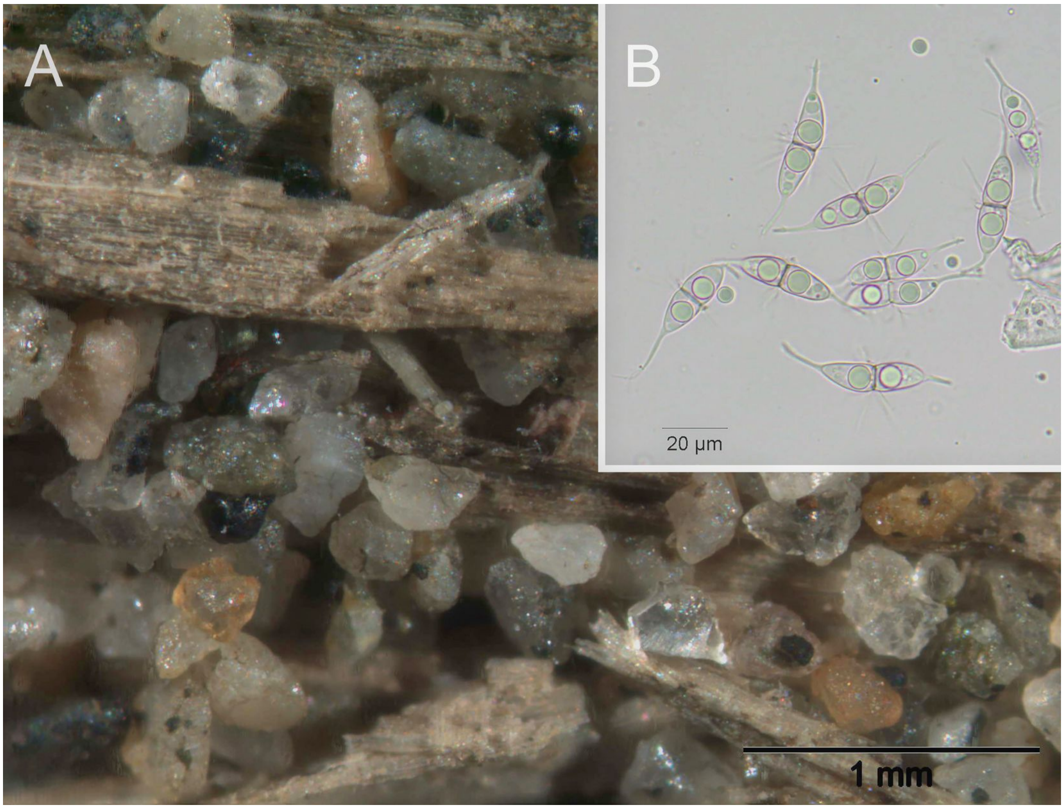

Figure 2. *Corollospora maritima* (TROM-F-26424). A) Black perithecia on sand grains and driftwood, B) ascospores with polar and equatorial appendages in light field. Photos: Teppo Rämä.

Figure 3. Ascomata of *Genea hispidula* (O-F-21106) photographed at the collection site in Rosnestangen (Moss) 1.9.2011. Photo: Thomas Læssøe.

Earle ex Konr. & Maubl. (synonym *L. glioderma* (Fr.) Maire).

The course resulted in altogether 612 observations that were registered and identifications verified by professional mycologists including Marie Davey, Gro Gulden, Klaus Høiland, Thomas Læssøe, Håvard Kauserud, Bjørn Nordén, Leif Ryvarden, Trond Schumacher, and Anders K. Wollan who functioned as teachers or assistant teachers during the field course. The list of observations can be found in the apendix of this Agarica volume and at and at www.artsobservasjoner.no under the project name "Field course in mycology_Drøbak2011" (Artsdatabanken 2017).

The resulting list includes 413 species of mostly macrofungi: 527 observations relate to basidiomycetes, 83 to ascomycetes, one to the zygomycete *Spinellus fusiger* (Link) Tiegh. and one to the myxomycete *Tubifera ferruginosa* (Batsch) J.F. Gmel.

The results, including rare, threatened and new species to Norway, highlight that events such as the mycology field course can be an inexpensive and effective way of increasing knowledge of species distributions and ecology, if data collection is structured in a functional manner and competent amateurs or professional mycologists verify species identification.

ACKNOWLEDGEMENTS

Håvard Kauserud and Anders K. Wollan from the University of Oslo, and the Research School in Biosystematics are acknowledged for organizing the course, Jørn R. Gustad, Thomas Læssøe, Hans-Otto Baral and Katriina Bendiksen for beautiful pictures and comments to the text. Thanks also to teachers and students for great lessons and vigorous course atmosphere.

Teppo Rämä

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Appendix: Hundreds of species observations and four ascomycetes new to Norway during a mycology field course. Agarica 38.
Table showing spcies observed during mycology field course in Drøbak 29.8.-2.9.2011

Locality: Smihagen naturreservat
Municipality, County: Frogn, Akershus
Date: 29.08.2011

Species	**Comment**
Agaricus arvensis	
Amanita crocea	
Armillaria borealis	
Artomyces pyxidatus	
Ascocoryne sarcoides	
Baeospora myosura	
Bisporella citrina	
Boletus pulverulentus	
Boletus subtomentosus	
Cantharellus cibarius	
Cheimonophyllum candidissimum	
Chlorociboria aeruginascens	
Chlorophyllum rhacodes	
Chondrostereum purpureum	
Clavariadelphus truncatus	
Clavulinopsis helvola	
Clitocybe gibba	
Coprinellus micaceus	
Coprinopsis atramentaria	
Crepidotus mollis	
Crepidotus variabilis	
Daedalea quercina	
Datronia mollis	
Dichomitus campestris	
Entoloma undatum	
Exidia	
Flammulaster limulatus	
Fomes fomentarius	
Fomitopsis pinicola	
Galerina marginata	
Ganoderma applanatum	
Gloeoporus dichrous	
Gymnopus confluens	
Helvella macropus	
Heterobasidion annosum	
Humaria hemisphaerica	
Hydnum rufescens coll.	
Hygrocybe chlorophana	
Hygrocybe glutinipes	
Hymenochaete rubiginosa	
Hymenochaete tabacina	
Hyphodontia aff. breviseta	
Hypholoma fasciculare	
Hypoxylon aff. rubiginosum	
Inonotus radiatus	
Laccaria laccata	
Lactarius bertillonii	
Lactarius glyciosmus	
Lactarius pyrogalus	
Lactarius tabidus	
Lactarius torminosus	
Lactarius uvidus	
Leccinum scabrum	
Lentinellus cf. cochleatus var. inolens	
Lenzites betulina	
Leotia lubrica	
Lycoperdon perlatum	
Marasmiellus ramealis	
Megacollybia platyphylla	
Mycena epipterygia	
Mycena galericulata	
Mycena haematopus	
Mycena inclinata	
Mycena polygramma	
Mycena pura	
Mycena renati	

Oligoporus caesius	
Oligoporus tephroleucus	
Otidea onotica	
Phallus impudicus	
Phellinus punctatus	
Phlebia radiata	
Phlebia rufa	
Pholiota mutabilis	
Phyllotopsis nidulans	
Piptoporus betulinus	
Pleurotus dryinus	
Plicaturopsis crispa	
Pluteus cervinus	
Polyporus varius	
Psathyrella	
Pucciniastrum areolatum	
Ramaria subdecurrens	
Russula aeruginea	
Russula gracillima	
Russula nigricans	
Russula ochroleuca	
Russula vesca	
Schizophyllum commune	
Sillia ferruginea	
Skeletocutis nivea	
Steccherinum fimbriatum	
Stereum rugosum	
Stereum subtomentosum	
Tatraea dumbirensis	New to Norway
Trametes hirsuta	
Trametes versicolor	
Trechispora mollusca	
Tremella mesenterica	
Trichaptum abietinum	
Tubifera ferruginosa	
Xylaria hypoxylon	

Locality: Humlesekkveien (Gjøfjell)
Municipality: Nesodden; Akershus
Date: 30.08.2011

Species	**Comment**
Agaricus arvensis	
Agaricus silvaticus	
Albatrellus confluens	
Albatrellus ovinus	
Amanita citrina	
Amanita fulva	
Amanita muscaria muscaria	
Amanita rubescens	
Amanita spissa	
Amanita virosa	
Ampulloclitocybe clavipes	
Armillaria borealis	
Ascocorticium anomalum	
Ascocoryne sarcoides	
Auriscalpium vulgare	
Bankera fuligineoalba	
Boletus badius	
Byssomerulius corium	
Calocera furcata	
Calocera viscosa	
Cantharellus cibarius	
Cerrena unicolor	
Chalciporus piperatus	
Chroogomphus rutilus	
Clavariadelphus ligula	
Clavariadelphus pistillaris	
Clavulina coralloides	
Clitocybe odora	
Collybia cirrata	
Cortinarius acutus	
Cortinarius alboviolaceus	
Cortinarius armillatus	
Cortinarius bolaris	
Cortinarius camphoratus	
Cortinarius caperatus	

Cortinarius cinnamomeus
Cortinarius gentilis
Cortinarius limonius
Cortinarius paleaceus
Cortinarius phoeniceus
Cortinarius rubicundulus
Cortinarius semisanguineus
Cortinarius traganus
Cortinarius trivialis
Cortinarius violaceus
Craterellus cornucopioides
Craterellus lutescens
Craterellus tubaeformis
Cudonia confusa
Cyathus striatus
Entoloma
Entoloma conferendum
Entoloma rhodopolium
Exobasidium vaccinii
Fomitopsis pinicola
Galerina marginata
Gloeophyllum odoratum
Gomphidius glutinosus
Gymnopilus penetrans
Helvella macropus
Hydnellum concrescens
Hydnellum ferrugineum
Hydnellum geogenium
Hydnellum suaveolens
Hydnum repandum
Hydnum rufescens coll.
Hygrocybe cantharellus
Hygrocybe insipida
Hygrocybe laeta
Hygrocybe miniata
Hygrophorus camarophyllus
Hygrophorus erubescens
Hygrophorus olivaceoalbus
Hymenochaete tabacina
Hypocrea leucopus
Hypocrea pulvinata
Kuehneromyces mutabilis
Laccaria amethystina
Lactarius bertillonii
Lactarius deterrimus
Lactarius helvus
Lactarius lignyotus
Lactarius scrobiculatus
Lactarius torminosus
Lactarius volemus
Leccinum aurantiacum
Leccinum niveum
Leccinum variicolor
Leccinum versipelle
Leccinum vulpinum
Lentinellus castoreus coll.
Leotia lubrica
Lepiota felina
Leucopaxillus giganteus
Lycoperdon nigrescens
Lycoperdon perlatum
Lycoperdon perlatum
Lycoperdon umbrinum
Mycena galopus
Mycena pura
Mycena rubromarginata
Mycena stylobates
Mycetinis scorodonius
Ophiostoma polyporicola
Otidea leporina
Otidea onotica
Paxillus involutus
Phellinus punctatus
Phellodon melaleucus
Phellodon niger
Phellodon tomentosus
Phlebiella sulphurea
Piptoporus betulinus

Plicaturopsis crispa
Pseudohydnum gelatinosum
Ramaria abietina
Ramaria apiculata
Ramaria botrytis
Ramaria eumorpha
Ramaria gracilis
Ramaria paludosa
Rhodocollybia butyracea butyracea
Rimbachia aff. bryophila
Russula foetens
Russula queletii
Russula vesca
Sarcodon glaucopus
Sarcodon imbricatus
Scutellinia scutellata
Stereum sanguinolentum
Suillus variegatus
Tremella encephala
Tricholoma album
Tricholoma fucatum
Tricholoma virgatum
Tylopilus felleus
Vesiculomyces citrinus
Xerocomus subtomentosus

Locality: kurslokalitet i Gjøfjell
Municipality: Nesodden, Akershus
Date: 30.08.2011

Cordyceps militaris
Elaphocordyceps ophioglossoides
Elaphomyces
Elaphomyces granulatus
Podophacidium xanthomelum
Proliferodiscus tricolor

Locality: Røerskogen
Municipality: Nesodden, Akershus
Date: 31.08.2011

Agaricus sylvaticus
Amanita citrina
Amanita fulva
Amanita pantherina
Amanita porphyria
Amanita rubescens
Ampulloclitocybe clavipes
Annulohypoxylon multiforme
Ascocorticium anomalum
Bisporella citrina coll.
Bjerkandera adusta
Boletus pruinatus
Calocera cornea
Cantharellus melanoxeros
Chlorencoelia versiformis
Chlorophyllum rhacodes
Clavaria zollingeri
IUCN status Vulnerable
Clavulina cinerea
Clavulina coralloides
Clavulinopsis corniculata
Clitopilus hobsonii
Cordyceps militaris
Cortinarius bolaris
Cortinarius camphoratus
Cortinarius caperatus
Craterellus sinuosus
Crucibulum laeve
Cudonia confusa
Cystoderma carcharias
Cystodermella granulosa
Cystolepiota seminuda
Daedalea quercina
Diatrypella quercina
Elaphomyces granulatus
Elaphomyces granulatus

Entoloma
Entoloma aff. hebes
Entoloma nitidum
Entoloma pleopodium
Entoloma versatile
Euepixylon udum
Eutypa flavovirens
Exidia glandulosa
Exidia truncata
Fistulina hepatica
Galerina
Ganoderma applanatum
Gymnopilus picreus
Gymnopus confluens
Gymnopus peronatus
Hemimycena
Hemimycena delectabilis
Humaria hemisphaerica
Hygrocybe ceracea
Hygrocybe chlorophana
Hygrocybe coccinea
Hygrocybe conica
Hygrocybe irrigata
Hygrocybe pratensis
Hygrocybe psittacina
Hygrocybe reidii
Hygrocybe reidii
Hypholoma fasciculare
Hypocrea strictipilosa
Hypoxylon rubiginosum
Inocybe
Inocybe fastigiata
Inocybe geophylla
Inocybe mixtilis
Laccaria amethystina
Laccaria laccata
Lactarius camphoratus
Lactarius lignyotus
Lactarius quietus
Lactarius spinosulus
Lactarius subumbonatus
Lactarius tabidus
Laetiporus sulphureus
Lasiosphaeria ovina
Leccinum quercinum
Leotia lubrica
Lepiota clypeolaria
Lepista flaccida
Limacella delicata
Lycoperdon nigrescens
Lycoperdon perlatum
Lycoperdon perlatum
Marasmius rotula
Melanoleuca grammopodia
Mycena abramsii
Mycena alba
Mycena erubescens
Mycena galericulata
Mycena inclinata
Mycena meliigena
Mycena pura
Mycena sanguinolenta
Naucoria bohemica
Nectriopsis candicans
New to Norway
Nitschkia grevillei
Otidea leporina
Otidea onotica
Paxillus involutus
Paxillus involutus
Phellinus punctatus
Phlebia radiata
Pholiota flammans
Pholiota mutabilis
Pluteus cervinus
Poculum firmum
Protocrea farinosa
Ramaria

Ramaria abietina
Ramaria eumorpha
Ramariopsis kunzei
Resupinatus poriaeformis
Rhodocybe fallax
Rickenella fibula
Russula queletii
Russula xerampelina coll.
Ruzenia spermoides
Scleroderma citrinum
Strossmayeria basitricha
Trichoglossum hirsutum
Tricholoma columbetta
Tricholoma lascivum
Tricholoma sulphureum
Tylopilus felleus
Xylaria hypoxylon
Xylaria hypoxylon

Locality: Rossnestangen
Municipality: Moss, Østfold
Date: 01.09.2011

Acanthonitschkea tristis
Acrospermum cf. adeanum
Agaricus cf. urinascens
Amanita fulva
Amanita pantherina
Annulohypoxylon multiforme
Antrodiella serpula
Bisporella citrina
Boletus edulis
Boletus reticulatus
Calocera cornea
Cantharellus cibarius
Chalciporus piperatus
Chroogomphus rutilus
Clavulina coralloides
Clitocybe fragrans
Coltricia perennis
Conocybe blattaria
Coprinellus micaceus
Corollospora maritima
New to Norway
Cortinarius delibutus
Cortinarius lucorum
Cortinarius sanguineus
Cortinarius saniosus s. lato
Cortinarius torvus
Cortinarius uliginosus
Cortinarius violaceus
Crepidotus calolepis
Datronia mollis
Delicatula integrella
Diatrype bullata
Diatrype disciformis
Entoloma
Entoloma
Entoloma araneosum
Entoloma euchroum
Entoloma cf. rhodopolium
Entoloma sericellum
Entoloma serrulatum
Erysiphe alphitoides
Genea hispidula
Gymnopus confluens
Gymnopus peronatus
Hebeloma theobrominum
Henningsomyces candidus
Humaria hemisphaerica
Hyalorbilia inflatula
Hygrocybe cantharellus
Hygrocybe coccinea
Hygrocybe psittacina
Hypholoma radicosum
Hypomyces
Hypoxylon fuscum
Hypoxylon howeianum
Hypoxylon petriniae

Inocybe geophylla
Lactarius aspideus
Lactarius aurantiacus
Lactarius camphoratus
Lactarius deliciosus
Lactarius deterrimus
Lactarius glyciosmus
Lactarius necator
Lactarius quietus
Lactarius semisanguifluus
Lactarius torminosus
Lactarius vietus
Leccinum aurantiacum
Leccinum scabrum
Leccinum variicolor
Leccinum versipelle
Marasmius limosus
Megacollybia platyphylla
Microglossum viride
Mycena galericulata
Mycena pura
Mycena purpureofusca
Mycena stipata
Mycoacia fuscoatra
Nectria episphaeria
Oligoporus caesius
Otidea
Otidea alutacea
Paxillus filamentosus
Peziza succosella
Phlebia tremellosa
Pholiota flammans
Pleurotus
Pleurotus pulmonarius
Pseudohydnum gelatinosum
Radulomyces confluens
Ramariopsis pulchella
Resupinatus applicatus
Russula alnetorum
Russula gracillima
Russula integra
Russula parazurea
Sebacina incrustans
Spinellus fusiger
Stereum subtomentosum
Suillus bovinus
Thelephora penicillata
Thelephora terrestris
Tomentella
Trichoderma citrinoviride
sexual state Hypocrea schweinitzii
Tricholoma columbetta
Tricholoma equestre
Tricholoma sciodes
Tricholoma sulphureum
Tubaria conspersa
Xerocomus badius
Xylaria carpophila

Locality: Håøya
Municipality: Frogn, Akershus
Date: 02.09.2011

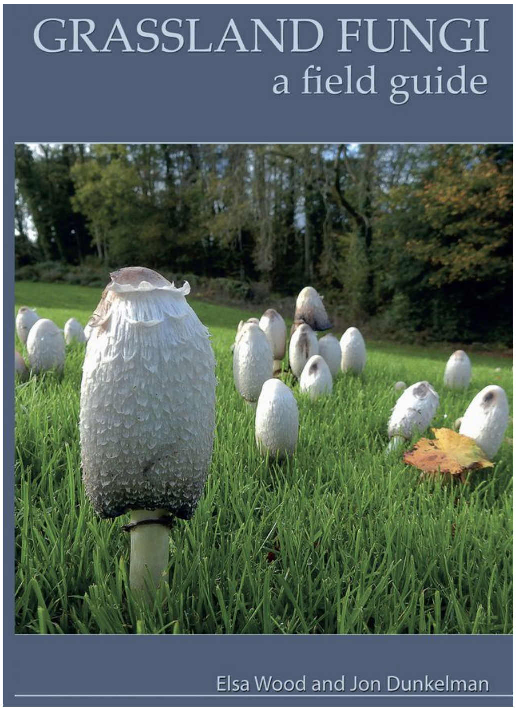
Albatrellus confluens
Albatrellus ovinus
Amanita citrina
Amanita fulva
Amanita muscaria muscaria
Amanita porphyria
Amanita rubescens
Amanita virosa
Ampulloclitocybe clavipes
Armillaria borealis
Artomyces pyxidatus
Auriscalpium vulgare
Boletus badius
Boletus edulis
Boletus subtomentosus
Calocera cornea

Cantharellula umbonata
Cantharellus cibarius
Cheimonophyllum candidissimum
Chroogomphus rutilus
Clavariadelphus truncatus
Clavulina cinerea
Clavulina coralloides
Clitocybe odora
Collybia tuberosa
Cortinarius alboviolaceus
Cortinarius anomalus
Cortinarius bolaris
Cortinarius brunneus
Cortinarius camphoratus
Cortinarius caperatus
Cortinarius delibutus
Cortinarius elatior
Cortinarius hinnuleus
Cortinarius nemorensis
Cortinarius purpurascens
Cortinarius rubicundulus
Cortinarius saginus
Cortinarius semisanguineus
Cortinarius traganus
Cortinarius trivialis
Cortinarius venetus
Cortinarius violaceus
Craterellus sinuosus
Daedalea quercina
Daedaleopsis confragosa
Dermoloma cuneifolium
IUCN status Vulnerable
Entoloma serrulatum
Fistulina hepatica
Fomes fomentarius
Fomitopsis pinicola
Geastrum quadrifidum
Gomphidius glutinosus
Gymnopus acervatus
Gymnopus confluens
Gymnopus peronatus
Helvella elastica
Hericium coralloides
Hericium coralloides
Hydnellum ferrugineum
Hydnellum suaveolens
Hydnum rufescens coll.
Hygrocybe cantharellus
Hygrocybe conica
Hygrocybe insipida
Infundibulicybe gibba
Inocybe geophylla
Kuehneromyces mutabilis
Laccaria amethystina
Laccaria laccata
Lactarius camphoratus
Lactarius deliciosus
Lactarius deterrimus
Lactarius fuliginosus
Lactarius lignyotus
Lactarius quietus
Lactarius repraesentaneus
Lactarius scrobiculatus
Lactarius thejogalus
Lactarius torminosus
Lactarius uvidus
Lactarius volemus
Leccinum aurantiacum
Leccinum carpini
Leccinum scabrum
Leccinum versipelle
Leotia lubrica
Lepiota clypeolaria
Lycoperdon nigrescens
Lycoperdon perlatum
Lycoperdon pyriforme
Microglossum olivaceum
IUCN status Vulnerable

Microglossum viride
Mycena haematopus
Mycena rosella
Mycena rosella
Oligoporus caesius
Ombrophila juniperinella
New to Norway
Otidea onotica
Paxillus involutus
Phellinus pini
Phellinus tremulae
Pholiota mutabilis
Piptoporus betulinus
Rhizomarasmius undatus
Rhodocollybia butyracea butyracea
Russula aeruginea
Russula decolorans
Russula integra
Russula nigricans
Russula parazurea
Russula sardonia
Russula xerampelina coll.
Scytinostroma portentosum
Sparassis crispa
Sphaerostilbella berkeleyana
Suillus bovinus
Suillus variegatus
Thelephora terrestris
Tricholoma album
Tricholoma fulvum
Tricholoma stiparophyllum
Tricholoma sulphureum
Xylaria hypoxylon

Grassland Fungi: A Field Guide

Elsa Wood, Jon Dunkelman, 2017. 336 s.
Monmouthshire Meadows Group.



Naturbeitemarker og andre såkalte semi-naturlige enger har en særegen funga med mange spesielle og dels rødlistede sopparter. Det er viktig at flere lærer disse artene å kjenne, derfor er det spennende å få en bok om «grassland fungi» i hånda. Boka er laget av en gruppe mennesker som studerer sopp i grasmarker i Wales, og er et resultat av to års arbeid. I Norge bruker vi begrepet beitemarksopp om arter av engvokssopper, rødsporer, jordtunger, finger- og køllesopper m.fl. Disse er omtalt i seksjon 1 i boka («Indicators of unimproved grassland»). I tillegg til disse omhandler denne boka også en del andre grupper som man kan finne i grasmarker, som hetter, traktsopper, grynhatter, sjampinjonger, kjeglesopper, flekkskivesopp, røyksopper mm. (seksjon 2-4), i tillegg til vedboende sopper og mykorrhiza-sopper knyttet til trær (seksjon 5). Boka har som målgruppe begynnere og mer erfarne «entusiaster». Den starter med en innledning, der det bl.a. forklares en del om kjennetegn og hva man skal se etter. Det står imidlertid ingenting om mikroskopiske kjennetegn og nødvendigheten av å studere disse. Resten av boka er for det meste bilder og makroskopiske beskrivelser. I mange av de omtalte slektene er det sånn at hvis man skal komme til art kommer man ikke utenom bruk av mikroskop, og til og med da kan det være vanskelig. Dette burde forklares tydeligere. En del av de typiske artene har fått to sider og mange bilder, mens andre er tildelt mindre plass. Engvokssoppene (*Hygrocybe* i vid forstand) er representert med en del arter, men det er likevel mange som mangler i denne viktige gruppa - som kanskje også er den gruppa som er lettest å studere makroskopisk og dermed passer for begynnere (akkurat her har vi jo et mye bedre alternativ – Boertmanns *Hygrocybe*-flora fra 2010). Man har tatt i bruk de nye slektsnavnene som splitter opp den gamle slekta i mange nye, da er det underlig at artene kommer hulter til bulter i en tilsynelatende tilfeldig rekkefølge uansett slekt. For mange andre grupper er artsutvalget også litt tilfeldig og dels magert, f.eks. er det bare med to jordtungearter.

I en bok som denne er bilder helt sentralt. Det første som slår leseren når man blar i boka er et betydelig antall bilder av dårlig kvalitet - uskarpe, dårlig dybdeskarphet, med litt unødig rusk og rask som kunne vært fjernet, utypiske bilder av mange arter og ikke minst feilbestemmelser. Bildet øverst side 93 og nederst s. 102 viser neppe beiterødspore *Entoloma sericeum*. Nederst t.h. s. 119 er angitt som hvit køllesopp *Clavaria acuta* (=*C. falcata*), men er tydelig gul, noe denne arten ikke skal være. Bildet nederst s.

128 er neppe svartlodnetunge *Trichoglossum hirsutum*, lodnetungene har svarte «hår» på overflata som gir dem et mattsvart utseende, mens denne er brun og glinsende. Bildene av lutrødspore *Entoloma rhodopolium* (s. 116), stankparasollsopp *Lepiota cristata* (s. 146-47), rosa melparasollsopp *Cystolepiota seminuda* (s. 148-149), og melsopp *Clitopilus prunulus* (s. 197) ser heller ikke tillitvekkende ut, og svekker generelt tilliten til boka som helhet. Spesialister på ulike grupper vil sikkert finne flere eksempler. Når man bruker opptil 5-6 bilder på en art, burde man vente til man har bilder som viser arten i typisk form, her er det betydelige mangler og mye ukritisk bildebruk. Viktigst er det likevel at forfatterne i mange tilfeller ikke makter å få fram de typiske kjennetegnene til artene ved hjelp av tekst og bilder, og villeder oss ved mange feil, og ved å unnlate å gå inn på nødvendigheten av mikroskopiske karakterer i mange tilfeller. Jeg ville heller ikke brukt 40 sider på vedboende og mykorrhizadannende sopparter, for disse artene er behørig omtalt i et utall andre soppbøker.

Denne boka gir utvilsomt et visst inntrykk av sopp-mangfoldet i grasmarkene, men kvalitetsmessig faller den gjennom. Samarbeid med fagpersoner kunne bidratt til å løfte den. Beitemarksopp-kjenneren Gareth Griffith er tydeligvis ikke konsultert, han holder til ved Universitetet i Wales som ikke skulle være så langt unna. For mange grupper av sopper i grasmark er litteraturen nokså fragmentert og uoversiktlig, og det er så absolutt behov for en bok om dette temaet. Jeg nøler likevel sterkt med å anbefale noen å kjøpe akkurat denne boka – uansett faglige behov og ambisjoner, vær i hvert fall klar over betydelige mangler og dels villedende informasjon, og det kan nok være verdt å vente på noe annet og bedre.

John Bjarne Jordal

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