

## Twenty species of bitunicate ascomycetes new to Norway

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Norsk tittel: 20 nye tykkseksopper for Norge

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### KEYWORDS

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

### NØKKELOORD

Barklevende, vedlevende, sekksporesopper, tykkseksopper

### 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 (Tykkseksopper) og fem arter tilhører underklassen Chaetothyriomycetidae i klassen Eurotiomycetes (Kulseksopper). 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



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

in the mainly lichenized Arthoniomycetes). Under the microscope, they share the traits of bitunicate asci, branched and anastomosing 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.

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 Sølvi 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 Sølvi 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 Sølvi (2016) estimated that over 500 additional species may occur in Norway. In this paper, we present 20 species new to Norway.

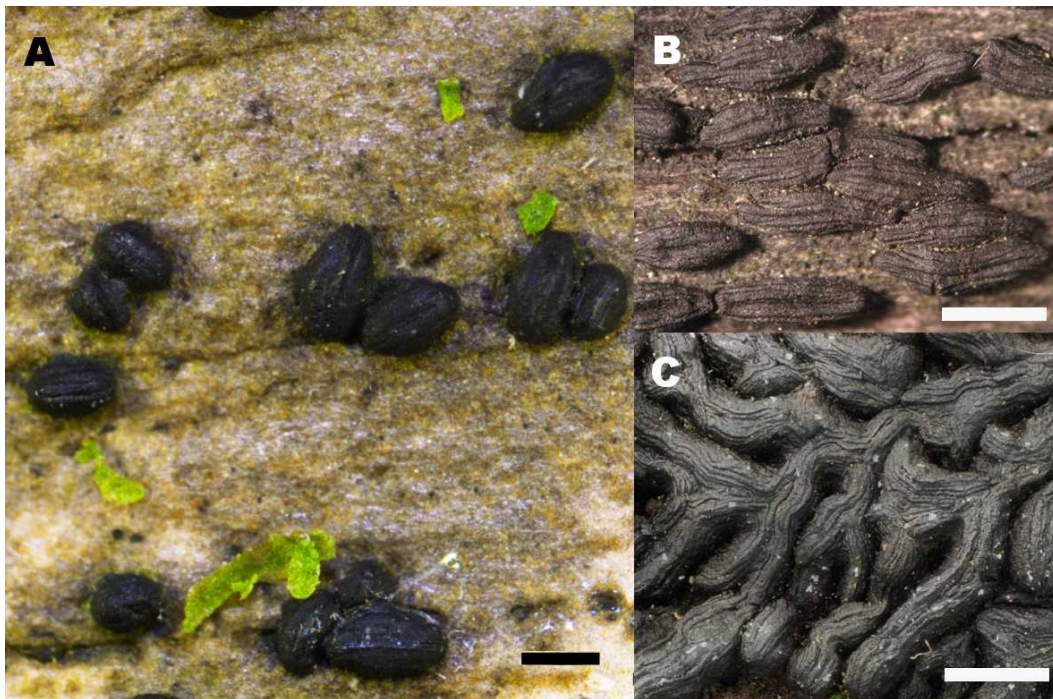


Figure 2. Hysterothecia lack pores and instead have slit-like openings. They come in various shapes but are usually black. A) *Hysterium pulicare*, a common species on the bark of various deciduous trees (scale bar = 0.5 mm). Photo: M. Jääntti, 2017. B) *Hysterographium flexuosum* (scale bar = 1 mm). 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 Jääntti, 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, Vassend-skreda, 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. stevensii*, 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. Ascospores 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 (Figure 3 and 6)**



Figure 3. *Capronia normandinae* ascospores 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  $13\text{--}15.5 \times 3.5\text{--}4.5 \mu\text{m}$ .

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

***Didymosphaeria massarioides* Sacc. &  
Brunaud (Figure 4)**

This species was previously reported from

northern Norway (Artskart 2017) and Sweden (Eriksson 2014) in Fennoscandia. It has small, inconspicuous 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,  $2.0\text{--}2.7 \times 1.1\text{--}1.4 \mu\text{m}$ .

Material: Vestfold, Tønsberg, Gullkronene naturreservat, UTM32 578486/ 6572761, on *Humulus lupulus*, October 25, 2013, leg. BN, det. BN, MJ. Akershus, Enebakk, Omberg,

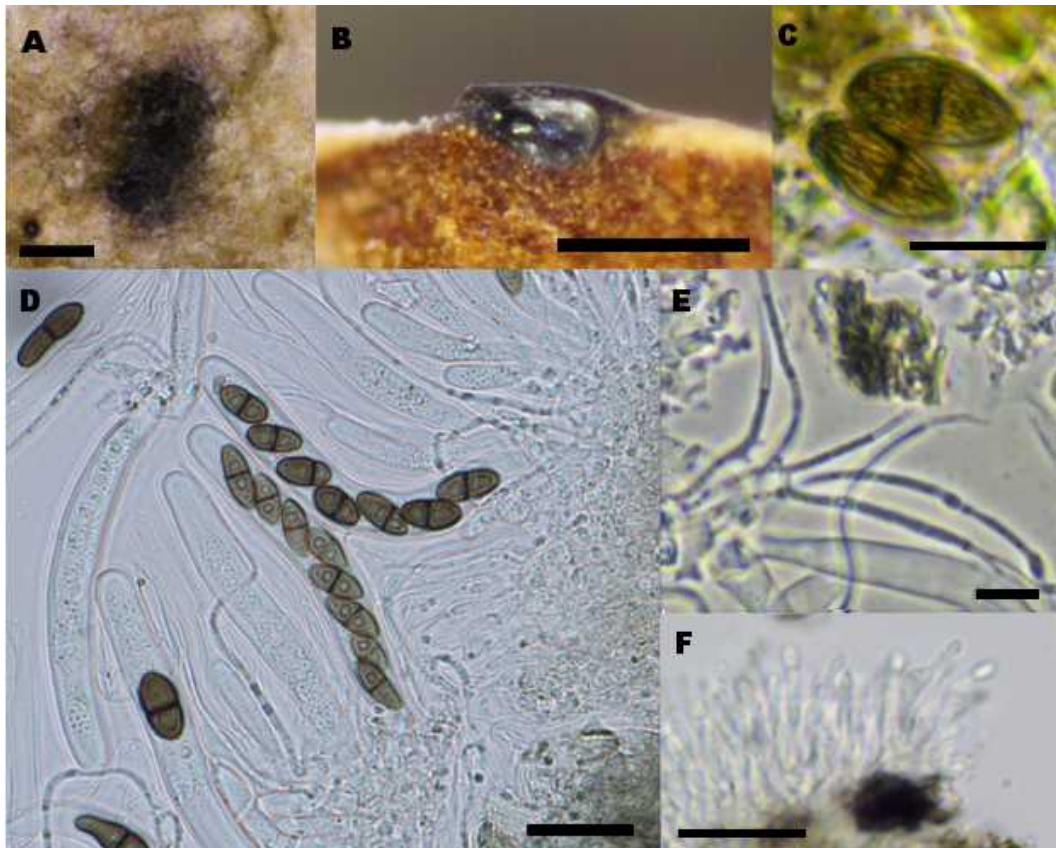


Figure 4. *Didymosphaeria massarioides*. A) Ascomata from above (scale bar = 100  $\mu\text{m}$ ), and B) in cross-section (scale bar = 200  $\mu\text{m}$ ), and C) spores showing the striate ornamentation (scale bar = 10  $\mu\text{m}$ ). D) Hymenium with asci and spores (scale bar = 20  $\mu\text{m}$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

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 ascumata 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. *Vaginatisspora 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** (Figure 5)



Figure 5. *Massaria platanoidea* ascomata. A) A cross-section and B) ascomata from above (scale bars = 500  $\mu$ m). 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  $\times$  4–5.5  $\mu$ m, and has bipolar appendages up to 2  $\mu$ m 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  $\times$  7.5–10  $\mu$ m) 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, 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



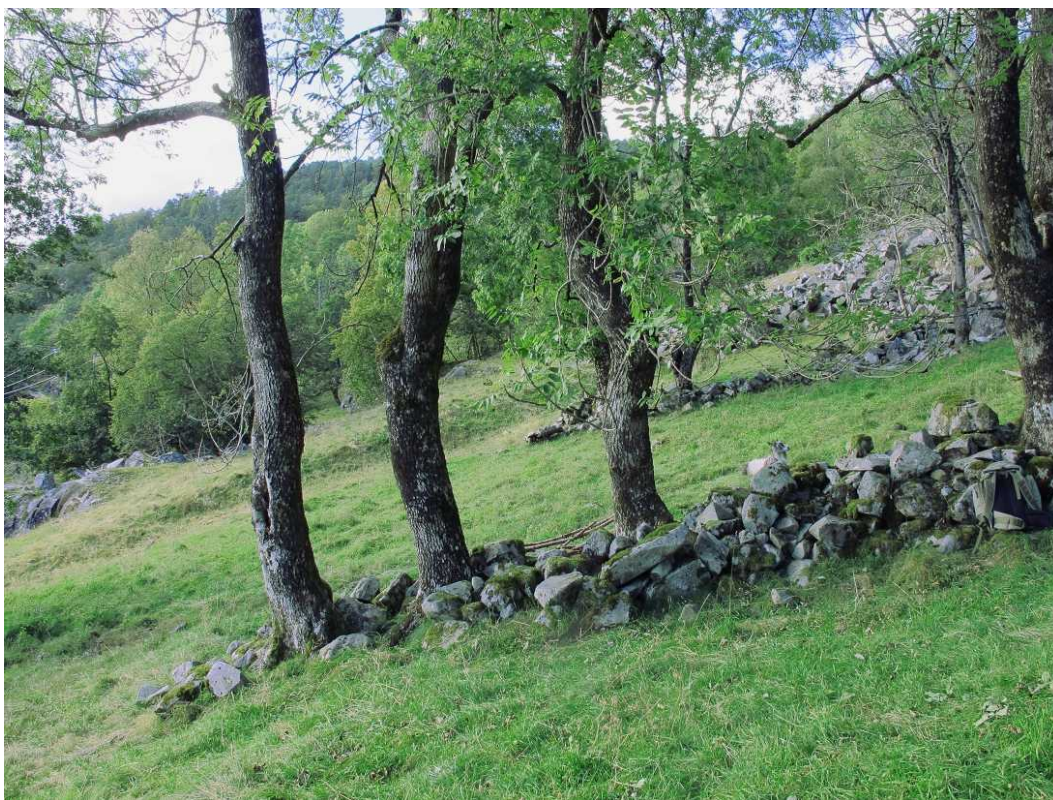


Figure 6. Habitat of *Capronia normandinae* and *Navicella elegans* in Alsåker aust (Kvernherad, Hordaland). The first species was found on the lichen *Normandina pulchella* and the second species was found on the bark, both on old *Fraxinus excelsior* trees. Photo: J. B. Jordal, 2013.

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** (Figure 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, Dømmes-



moen, 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,  $80\text{--}88 \times 15\text{--}16,5 \mu\text{m}$ .

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.

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