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26

A. Granmo

Morphotaxonomy and chorology of the genus *Hypoxylon* (Xylariaceae) in Norway

1999

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The Norwegian species of *Hypoxylon* have been treated with respect to their ecology, morphology and taxonomy. Their host trees have been identified and percentage frequency of each host and substrate type (bark/wood) calculated. Ecologically the species are grouped according to their saprobic ability, and to their preferred hosts and substrates (bark or wood). From a chorological point of view the species are grouped into three different geoelements according to the distributional centre for each species in Norway, thereby also taking into consideration the total Nordic distribution. Complete locality lists for each species are given and a key to all Nordic species is presented.

Twelve species of *Hypoxylon* have so far been recognized in Norway: *Hypoxylon cercidicola*, *H. cohaerens*, *H. fragiforme*, *H. fuscum*, *H. howeianum*, *H. laschii*, *H. macrosporum*, *H. multiforme*, *H. porphyreum*, *H. rubiginosum*, *H. salicicola* and *H. vogesiacum*. Two species belong to *Hypoxylon* sect. *Annulata*: *Hypoxylon cohaerens* and *Hypoxylon multiforme*, the remainder belong to *Hypoxylon* sect. *Hypoxylon*. Two new species are described: *H. porphyreum* and *H. salicicola*. In a previous treatment of Nordic species of *Biscogniauxia* and *Hypoxylon*, *Hypoxylon cercidicola* and *H. salicicola* were included in and reported as *H. rubiginosum* and *H. rutilum*, respectively, while *H. porphyreum* was included in *H. fuscum*. *Hypoxylon macrosporum* and *H. laschii*, by several authors considered as varieties of *H. vogesiacum* and *H. rubiginosum*, respectively, are treated as species.

Keywords: Ascomycota, chorology, distribution, ecology, *Hypoxylon*, morphology, Norway, taxonomy, Xylariaceae.

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CONTENTS

INTRODUCTION

Bulliard's genus *Hypoxylon* from 1791 included 16 species, comprising taxa now considered to belong in about twelve different genera (among others *Biscogniauxia*, *Bombardia*, *Cytospora*, *Nectria*, *Rosellinia*, *Xylaria*). Only three species remain in *Hypoxylon*: *Hypoxylon coccineum* (= *H. fragiforme*), *H. glomerulatum* (= *H. fuscum*) and *H. granulosum* (= *H. multiforme*). The emendation of *Hypoxylon* by Fries (1849) still included a heterogeneous assemblage of pyrenomycetous fungi, although the bulk constituted the present-day *Hypoxylon* species or species in related genera. Nitschke (1867) disposed of *Hypoxylon* in a way largely adopted by Miller in the first monograph of the genus (Miller 1961). Miller's amended concept of *Hypoxylon* comprised 120 taxa, including applanate species now belonging to *Biscogniauxia* Kuntze and *Camillea* Fr. In addition, about one third of Miller's *Hypoxylon* sect. *Papillata* subsect. *Primocinerea* are now recognized under the genus *Nemania*. At the 11th International Botanical Congress in Seattle in 1969, *Hypoxylon* Bull. was conserved against earlier homonyms and *Sphaeria* Haller, with the type species *H. fragiforme* (Pers.: Fr.) J. Kickx f.

Ju & Rogers (1996) monographed *Hypoxylon* anew. The genus was maintained in a restricted sense, largely corresponding to Miller's sections *Hypoxylon*, *Annulata*, *Papillata* subsect. *Papillata*, and a few species in subsect. *Primocinerea* besides those arranged in *Nemania*. Only two sections were recognized: sect. *Hypoxylon* and sect. *Annulata*. Thus, *Hypoxylon* s. str. at present comprises about 128 taxa of which no fewer than 38 were described as new by Ju and Rogers.

The first account of Norwegian species of *Hypoxylon* (s. Miller) was presented by Granmo (1977) in an unpublished thesis. Later on, the species were reconsidered on a Nordic base by Granmo et al. (1989). The present paper is based on the revision of the Norwegian species by Granmo (1998). Prior to these publications, the most adequate records for Norway were those of Sommerfelt (1826, 1827) and Rostrup (1904).

The present study aims at giving an updated account of taxonomy, ecology and chorology of the Norwegian species of *Hypoxylon* s. str., providing comprehensive descriptions of species and locality lists up to 1996.

INVESTIGATION AREA

SITUATION AND DIVISION

Norway is situated between lat. 58-71 °N and long. 4.5-31 °E. The country is divided into 19 counties (administrative provinces; Fig. 1). Akershus (county 2 on the map) is here jointly considered with the urban county Oslo. The counties are subdivided into a total of 435 municipalities, used in the locality lists.

THE VEGETATION REGIONS OF NORWAY

Because of the extremely varied topography and climate in Norway, the delimitation of vegetation regions is more complex than for the other Nordic countries. The following descriptions of these regions, and the map (Fig. 2), are somewhat simplified from those of Dahl et al. (1986).

(1) Nemoral region (*Temperate deciduous forest region*). The oak forest region with frost-sensitive, southern species.

(2) Boreonemoral region. Dominated by woods of conifers, birch (*Betula*) and grey alder (*Alnus incana*). In favourable localities broad leaved deciduous woods with oaks (*Quercus robur* and *Q. petraea*), ash (*Fraxinus excelsior*), elm (*Ulmus glabra*), lime (*Tilia cordata*) and hazel (*Corylus avellana*) occur. The region forms a transition zone between 1 and 3.

(3) Southern boreal region. Dominated by coniferous woods, interspersed with wide areas of alder (*Alnus glutinosa*) woods and mires. Southern deciduous trees occur locally, including for example *Betula pendula*.

(4) Middle boreal region. Dominated by coniferous forests, and birch woods towards the west and in the north. Grey alder (*Alnus incana*) woods are present while southern deciduous trees are lacking. Mires cover extensive areas.

(5) Northern boreal and alpine regions. The *northern boreal region* is dominated by birch (*Betula pubescens*) woods, sparse low-yielding coniferous woods and minerotrophic mires. It is vertically limited by the climatic timber line, above which are the *low-*, *middle* and *high alpine regions*. Heathers (*Empetrum*, *Vaccinium*) and shrubs (*Betula nana*, *Salix glauca*, *S. lanata* and *S. lapponum*) are common only in the *low alpine region*.

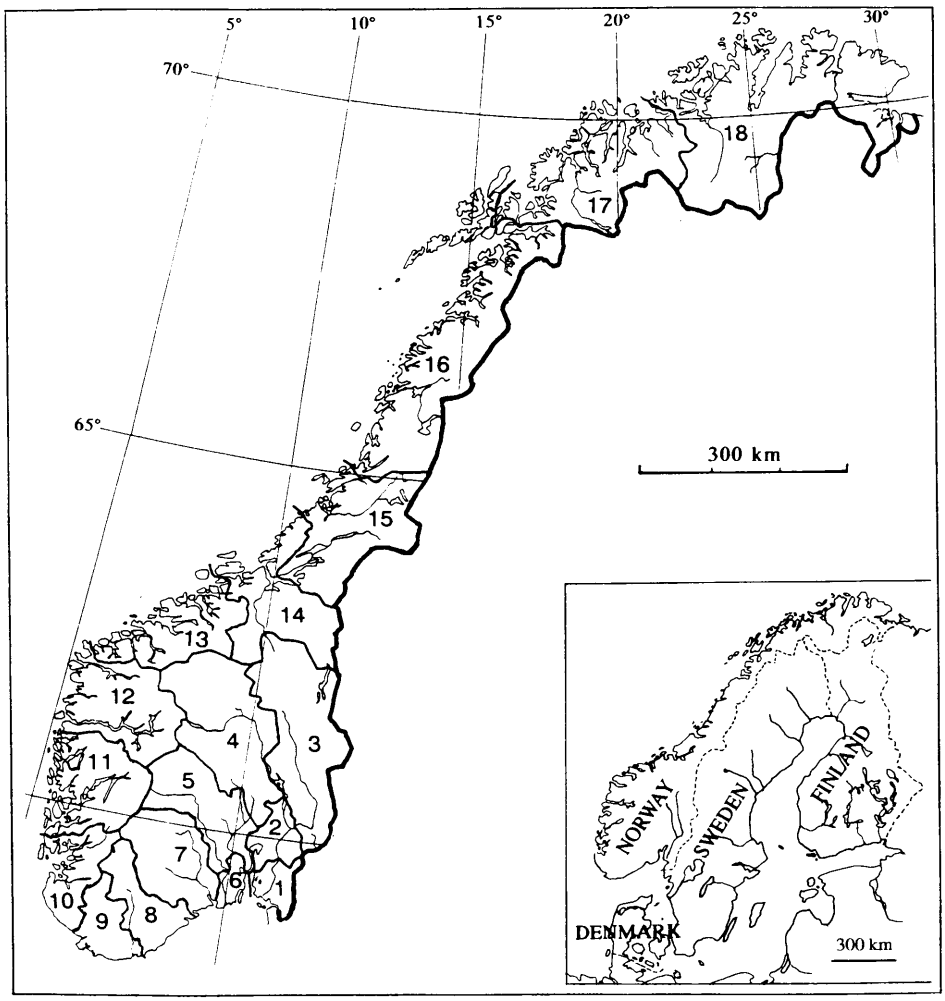


Fig. 1. The counties of Norway. 1 – Østfold (Øs), 2 – Akershus including Oslo (Ak), 3 – Hedmark (He), 4 – Oppland (Op), 5 – Buskerud (Bu), 6 – Vestfold (Ve), 7 – Telemark (Te), 8 – Aust-Agder (AA), 9 – Vest-Agder (VA), 10 – Rogaland (Ro), 11 – Hordaland (Ho), 12 – Sogn og Fjordane (SF), 13 – Møre og Romsdal (MR), 14 – Sør-Trøndelag (ST), 15 – Nord-Trøndelag (NT), 16 – Nordland (No), 17 – Troms (Tr), 18 – Finnmark (Fi). - Insert: The Nordic countries excluding Iceland and the Faeroe Islands.

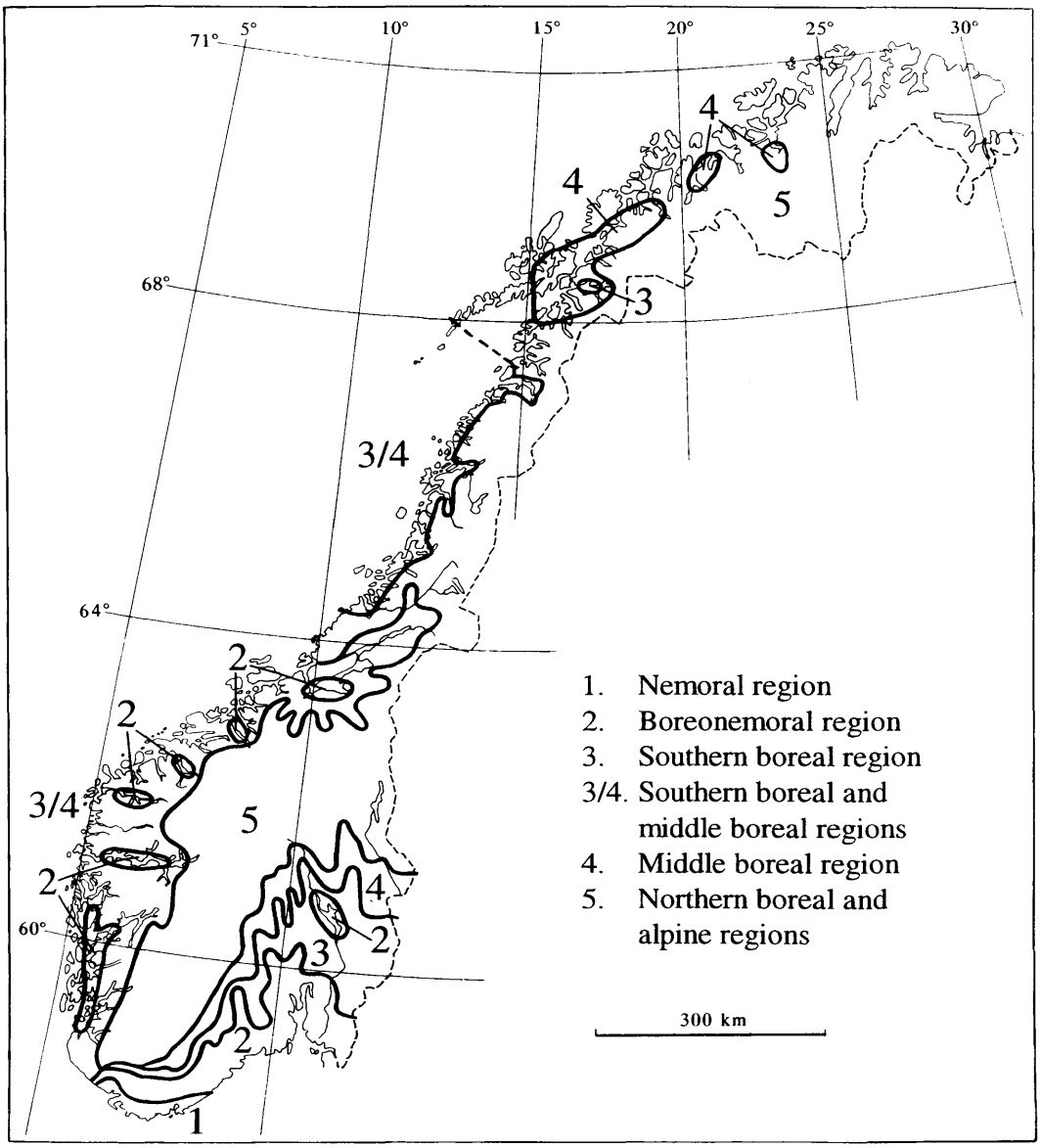


Fig. 2. Simplified map of the vegetation regions of Norway. Modified from Dahl et al. (1986).

MATERIALS AND METHODS

A list of abbreviations is given in the Appendix.

MATERIALS

The Norwegian material of *Hypoxylon* s.l. examined in this study originates mainly from the Norwegian university herbaria of Oslo (O), Bergen (BG), Trondheim (TRH), and Tromsø (TROM). A few additional collections from Norway were localized in other Nordic herbaria. The bulk of the material in BG and TROM was collected by the author in the periods 1973-1976 and 1994-1995. All parts of the country were visited, though the southeastern parts, and the county of Finnmark, were more superficially investigated. The collections were dried either at room temperature or at slightly raised temperatures (30-40 °C), mostly succeeded by one week at -42 °C to kill infecting insects. Since most specimens lacked herbarium accession numbers, the examined material has been given consecutive numbers within each species for unambiguous reference. Herbarium abbreviations are according to Holmgren et al. (1990).

The term 'host' as applied here refers to the type of wood, or tree, inhabited by the fungus. Whenever possible, wood samples have been determined to genus. North European types of wood are usually easy to recognize, though *Salix* and *Populus* are readily confused, depending on the state and size of the sample. Due to the low number of native tree species, *Alnus* usually means *A. incana* or, infrequently, *A. glutinosa*, *Betula* means *B. pubescens* or, rarely, *B. pendula* (= *B. verrucosa*); *Corylus*, *Fagus* and *Fraxinus* are *C. avellana*, *F. sylvatica* and *F. excelsior*, respectively, and *Populus* and *Prunus* are *P. tremula* and *P. padus*; *Quercus* means *Q. petraea* or *Q. robur*; *Salix* comprises several taxa, while *Sorbus*, *Tilia* and *Ulmus* are *S. aucuparia*, *T. cordata* and *U. glabra*, respectively. For collections verified as to host, the substrate for the specimens were noted, i.e. bark (b), wood (w), or both (bw). In calculations (Tabs 2, 4) only these verified vouchers were used.

METHODS

Ecology

All taxa have been found on dead or decaying parts of trunks and branches of deciduous trees. The state of decay may, however, vary considerably. The species were divided into two groups according to saprobic ability: (1) *primary saprobes*, which sporulate on wood at an early stage of decay, and (2) *secondary saprobes*, which produce sporophores on moderately to strongly decayed wood, and never or only rarely have been found on fresh wood

As regards host preference, three groups could be distinguished: (1) the *host genus-selective*

species had a strong preference for only one or two particular host species (or rather host genera), appearing infrequently on additional hosts, (2) the *host family-selective* species had a preference for one or a few particular host families, and (3) the *host-indifferent* species occurred on numerous hosts from several host families, without preference for one. The classification into types of host association used in this study only take into account the hosts on which the sexual reproductive phase is completed. Nothing can be said for sure about the frequency and distribution of a mycelial stage in these or other host trees.

Three groups of taxa could be distinguished with regard to substrate preference: (1) species which solely or largely preferred bark, and (2) species which mostly occurred on wood, and (3) species which were frequently found on both types of substrate.

Chorology

A chorological grouping of the species into three distributional groups, *geoelements*, was made, mainly by consideration of their centre of distribution in terms of occurrence of ascomata, rather than the actual geographical limits of the taxa.

Morphology

Stroma measurements are given for length (parallel to the wood fibres) × width × thickness. The maximum height and width of the perithecium include walls; the height is up to the perithecial-ostiolar junction. Peridium thickness is measured at the side-bottom transition.

Microscopic characters were generally observed and measured in water. Measurements in strong lactic acid or glycerol have been avoided as they may give a noticeable increase in spore width due to collapse of the spore. The hyaline dehiscent perispore, 0.3-0.8 μm thick, common in the ascospores of *Hypoxylon*, is not included in the spore measurements. The ascal stipes are considered only in fully mature asci, and even then vary greatly, and often expand after a while in water mounts. Ascus and ascospore dimensions are given as intervals with extreme values in parentheses. Mean values are calculated from a given number (n) of single measurements and specimens.

The amyloidity (blueing) of the ascus annulus was tested in Melzer's reagent (MZ; I/KI/chloral hydrate/water = 0.5/1.5/20/20 in units by weight). A weak MZ reaction may be made distinct by pretreating the mount with 2% KOH, followed by MZ. Slides are kept as dried water mounts, sealed with nail varnish. In some cases the colour of extractable stromatal pigments in 10% KOH (under cover glass on a slide) was viewed with the naked eye in daylight (cf. Ju & Rogers 1996: 8). The coding for external colours of stromata in daylight, and of ascospores under the microscope, is according to Kornerup & Wanscher (1967).

A Zeiss Standard microscope (max. magnification 12.5 × 100) was used, with the aid of a camera lucida for drawing, and a Zeiss MC 63 camera unit for microphotography. Macrophotographs were taken with a Pentax camera with a 50 mm macro lens and extension rings, and illuminated by two 150 W lamps (each 3200 °K), supplemented with a white paper reflector. SEM photographs were made with a JEOL JSM 5300 microscope. Spore preparations were made from spores suspended in a drop of water deposited on a cover glass (13 mm diam.) which was glued to the SEM aluminium stub with a silver glue solution. The suspension was

allowed to air dry and was then stored in an exsiccator for 3 days before being coated with gold in an argon atmosphere (Schumacher 1990).

MORPHOLOGICAL TERMINOLOGY

Stromata

The term *ectostroma* is used in accordance with Miller (1928) for the outer, dense layer of the stroma, which is differentiated from the interior *entostroma* by its colour, consistency or tissue type. The ectostroma often has a superficial covering of amorphous granules, mycelial remnants of the anamorph, and sometimes crystals, which here is called *pruina*. The entostroma has a more or less well developed basal part (*basal entostroma*) below the perithecia, which at times incorporates fragments of host tissue.

Perithecia

Perithecia are usually found in one row located in the outer part of the entostroma. The ectostroma sometimes bulges out by the growth of perithecia and ostioles so that the surface looks uneven or even rough due to the perithecial elevations. The perithecial wall or peridium has a carbonaceous outer layer in sect. *Annulata*, which is lacking in sect. *Hypoxylon* (cf. also Ju & Rogers 1996).

The *ostiole* is the perithecial neck with its canal, which opens in a pore, and its immediate surrounding stroma. Two main types of ostioles are found in *Hypoxylon*. The *umbilicate* ostiole opens in a navel-like manner in or below the stromal surface, usually with a visible rim of the neck-wall surrounding the pore. A subtype is the *punctate* ostiole, which opens by a simple pore in the ectostroma without a visible rim. In the main, *papillate* type, the ostioles project above the stromatal surface, and its *annulate* subtype is encircled by a small disk or circular depression at its base caused by loss of the overlying ectostroma. No typical representative of this subtype is found in any Nordic species of *Hypoxylon*. With few exceptions, the umbilicate ostioles belong in *Hypoxylon* sect. *Hypoxylon*, while the papillate ostioles belong in *Hypoxylon* sect. *Annulata*.

Asci, paraphyses and ascospores

These parts are quite uniform and typically xylariaceous. The cylindrical *asci* with 8 uniseriate or overlapping uniseriate spores have a conspicuous stipe. The inner wall membrane at the ascus apex conforms with the proximal part of the ascus *annulus* (ring) in the wall, resembling a three- -pronged apical 'crown'. The ascus annulus is broader than high (discoid). The annuli are usually amyloid, though there may be intraspecific variation in this reaction. *Paraphyses* are present as ribbon-shaped to filiform hyphae surpassing the asci in length. They are septate, more or less branched and hyaline with yellow guttules.

The *ascospores* are generally inequilaterally ellipsoid and slightly inequipolar with the

narrower end generally oriented towards the ascal base. They are brown, with a hyaline or yellowish, mostly dehiscent perispore, with a germ slit on the more convex (*dorsal*) side. In most species of *Hypoxylon* sect. *Hypoxylon*, the perispore is transversally striate (rarely visible except by SEM), while species of sect. *Papillata* have a smooth perispore with a slight thickening toward one end (cf. Ju & Rogers 1996).

Anamorphs

Due to extensive culturing of ascomycetes including Xylariaceae over the last decades, the anamorph stages of numerous species of *Hypoxylon* have now been established. Ju & Rogers (1996) made schematic drawings of the actual genera for *Hypoxylon*, and maintained that they differed only in complexity in terms of conidiophore branching, all being referable to the form genus *Nodulisporium*. Thus, the simplest is *Sporothrix* (*Sporothrix*-like sec. Ju & Rogers 1996) continuing through the gradually more complex types: *Virgariella* (*Virgariella*-like), *Nodulisporium* (*Nodulisporium*-like) and *Periconiella* (*Periconiella*-like). Thus, sect. *Annulata* includes the *Nodulisporium*-like anamorph, and in a few taxa *Virgariella* and *Periconiella*, while sect. *Hypoxylon* mainly has the *Nodulisporium*-like anamorph and *Virgariell*a, and a few species have *Periconiella* and *Sporothrix*

RESULTS

ECOLOGY

Saprobic types

Some of the primary saprobes (see Tab. 1) were probably early invaders, or possibly latent invaders. Thus *Hypoxylon cohaerens* and *H. fragiforme* were found with fully mature stromata at an early stage of decay on corticated logs or newly fallen branches of *Fagus*. These species also appeared as weak competitors with a relatively short life span on the host.

Hypoxylon porphyreum on *Quercus* and *H. fuscum* on *Corylus* and *Alnus* may also belong to the latent invaders, because some injured *Quercus* and *Corylus* shrubs were suspected to have been damaged by these fungi. In contrast to *H. porphyreum*, *H. fuscum* seemed to have a more long-lasting capacity to exploit the substrate and to compete with other fungi, as mature stromata were found also on well deteriorated wood.

Hypoxylon vogesiacum, in particular, and *H. macrosporum* as well, occurred regularly on dead, dry trunks and branches, penetrating deep into the wood and producing black mycelial zones. Judging from observations of wood attacked by some of these primary saprobes, the greyish colour inside the mycelial zones indicated that they have the capacity to degrade both cellulose and lignin. However, a brown or greyish brown rot was often conspicuous in the wood beneath the stromata of *H. vogesiacum*.

Of the secondary saprobes, the two species *H. cercidicola* and *H. salicicola* were occasionally also observed on externally fairly fresh wood. Owing to few observations, however, nothing further could be said about their affiliation to ecological group.

Host relationships

Preference for a particular host or group of hosts was evident for most species investigated (Tabs 2-3). *Hypoxylon rubiginosum* was considered as host-indifferent, despite its more common occurrence on *Ulmus* and *Fraxinus*. *H. multiforme*, with strong preference for Betulaceae, also showed preference for the systematically remote Rosaceae.

Although searched for, no species of *Hypoxylon* have so far been encountered on conifers in Norway.

Tab. 1. Grouping of Norwegian *Hypoxylon* spp. according to saprobic ability.

Saprobic ability	Species
Primary saprobes	*H. cohaerens*
	H. fragiforme
	H. fuscum
	H. macrosporum
	H. vogesiacum
Secondary saprobes	*H. howeianum*
	H. multiforme
	H. rubiginosum

Tab. 2. Species of *Hypoxylon* and their percentage frequency on recorded host genera in Norway. The hosts are grouped systematically (Betulaceae and Fagaceae both belong to the order Fagales; all other host families belong to separate orders). n – number of collections.

Species	n	Hamamelidae							Dilleniidae			Rosidae				Asteridae
		Betulaceae				Fagaceae		Ulmaceae	Salicaceae		Tiliaceae	Aceraceae	Rosaceae			Oleaceae
		Alnus	*Betula*	*Carpinus*	*Corylus*	*Fagus*	*Quercus*	*Ulmus*	*Populus*	*Salix*	*Tilia*	*Acer*	*Prunus*	*Pyrus*	*Sorbus*	*Fraxinus*
H. cercidicola	11	·	·	·	·	·	·	·	·	·	·	·	·	·	·	**100.0**
H. cohaerens	22	·	·	·	·	**100.0**	·	·	·	·	·	·	·	·	·	·
H. fragiforme	24	·	·	·	·	**100.0**	·	·	·	·	·	·	·	·	·	·
H. fuscum	251	38.6	2.0	0.4	58.2	·	·	·	·	·	·	·	0.8	·	·	·
H. howeianum	16	12.5	·	·	81.3	·	6.3	·	·	·	·	·	·	·	·	·
H. laschii	2	·	·	·	·	·	·	·	**100.0**	·	·	·	·	·	·	·
H. macrosporum	168	·	·	·	·	·	·	·	·	**100.0**	·	·	·	·	·	·
H. multiforme	467	31.5	48.4	·	2.8	1.1	0.2	·	1.1	0.6	·	0.9	5.4	·	8.3	·
H. porphyreum	22	·	·	·	·	·	**100.0**	·	·	·	·	·	·	·	·	·
H. rubiginosum	39	5.1	·	·	·	7.7	2.6	23.1	7.7	7.7	5.1	10.3	·	·	7.7	23.1
H. salicicola	22	·	·	·	·	·	·	·	**100.0**	·	·	·	·	·	·	·
H. vogesiacum	33	·	·	·	·	·	·	81.8	·	·	·	3.0	·	3.0	·	12.1

Tab. 3. Norwegian species of *Hypoxylon* grouped according to host preference. Species given in parentheses are host selective, but occur on more than one host taxon.

Host preference type	Hosts	*Hypoxylon* species
Genus-selective	*Fagus*	*H. cohaerens*, *H. fragiforme*
	Fraxinus	*H. cercidicola*, (*H. vogesiacum*)
	Quercus	*H. porphyreum*
	Salix	*H. macrosporum*, *H. salicicola*
	Ulmus	(*H. vogesiacum*)
Family-selective	Betulaceae	*H. fuscum*, *H. howeianum*, (*H. multiforme*)
	Rosaceae	(*H. multiforme*)
Indifferent		*H. rubiginosum*

Corticolous and lignicolous species

The group of species which solely or largely preferred bark comprised *Hypoxylon cohaerens*, *H. fragiforme*, *H. fuscum*, *H. howeianum* and *H. multiforme*, whereas *H. macrosporum*, *H. rubiginosum*, *H. salicicola* and *H. vogesiacum* mostly occurred on wood (Tab. 4). Somewhat less discriminating in this connection were *H. porphyreum* and *H. cercidicola*, which were frequently found on both types of substrate. *Hypoxylon macrosporum* very rarely occurred on bark, the large percentage on both substrates being explained by stromata on wood growing close to or on the margins of adjacent bark.

When growing on bark, the stromata of most *Hypoxylon* spp. developed fully exposed, with the stromatal hyphae evidently piercing the bark and very early emerging outside. Innate stromata (like the extra-Nordic *Hypoxylon moravicum*) were observed in *H. laschii*, and, at times, in *H. multiforme*, forcing themselves through the bark at maturation.

CHOROLOGY

As might be expected from their host ecology, some taxa showed a distribution largely corresponding with those of their host trees, which in turn was related to the division of Norway into vegetation regions (Fig. 2). There were, however, often conspicuous deviations from this picture of fungus-host distribution, suggesting importance of factors other than simply the presence of an appropriate host. Tab. 5 shows the distribution of species on geoelements. The *widely distributed* species were found in nearly every part of the country. The *southern* species had their main occurrence in the nemoral, boreonemoral and southern boreal regions, i.e. Norway south of 65 °N, though with possible scattered occurrences further north. The *northern* species had their main distribution north of 65 °N, and/or in north and middle boreal and low alpine regions.

Tab. 4. Species of *Hypoxylon* and their percentage frequency on recorded host genera and substrate types in Norway. n – number of collections.

Species	n	Distribution on host genera and substrate type				Distribution on substrate type		
		Host genus	bark	wood	both	bark	wood	both
H. cercidicola	11	*Fraxinus*	18.2	54.6	27.3	18.2	54.6	27.3
H. cohaerens	22	*Fagus*	**100.0**	·	·	**100.0**	·	·
H. fragiforme	24	*Fagus*	**100.0**	·	·	**100.0**	·	·
H. fuscum	251	*Alnus*	35.1	2.0	1.6	90.5	4.8	4.8
		Betula	1.2	0.8	·			
		Carpinus	0.4	·	·			
		Corylus	53.0	2.0	3.2			
		Prunus	0.8	·	·			
H. howeianum	16	*Alnus*	6.3	6.3	·	93.8	6.3	·
		Corylus	81.3	·	·			
		Quercus	6.3	·	·			
H. macrosporum	168	*Salix*	0.6	76.8	22.6	0.6	76.8	22.6
H. multiforme	467	*Alnus*	22.9	4.3	4.3	72.4	19.0	8.6
		Betula	37.0	8.8	2.6			
		Corylus	2.1	0.4	0.2			
		Fagus	·	0.6	·			
		Quercus	·	0.2	·			
		Populus	·	0.6	0.4			
		Salix	0.2	0.4	·			
		Acer	·	0.9	·			
		Prunus	3.0	1.7	0.6			
		Sorbus	6.6	1.1	0.4			
H. porphyreum	20	*Quercus*	65.0	15.0	20.0	65.0	15.0	20.0
H. rubiginosum	39	*Alnus*	·	5.1	·	2.6	92.3	5.1
		Fagus	·	7.7	·			
		Quercus	·	2.6	·			
		Ulmus	·	23.1	·			
		Populus	2.6	5.1	·			
		Salix	·	7.7	·			
		Tilia	·	5.1	·			
		Acer	·	5.1	5.1			
		Sorbus	·	7.7	·			
		Fraxinus	·	23.1	·			
H. salicicola	22	*Salix*	·	**81.8**	18.2	·	**81.8**	18.2
H. vogesiacum	33	*Ulmus*	·	81.8	·	·	**100.0**	·
		Acer	·	3.0	·			
		Pyrus	·	3.0	·			
		Fraxinus	·	12.1	·			

Tab. 5. Norwegian species of *Hypoxylon* arranged according to occurrence in vegetation regions and classification into geoelements. Vegetation regions: N - nemoral; BN - boreonemoral; SB - southern boreal; MB - middle boreal; NB - northern boreal; LA - low alpine. + - common; (+) - few records.

Species	Vegetation region						Geoelement
	N	BN	SB	MB	NB	LA	
H. cohaerens	+	+	·	·	·	·	southern
H. fragiforme	+	+	·	·	·	·	southern
H. porphyreum	(+)	+	·	·	·	·	southern
H. howeianum	+	+	(+)	·	·	·	southern
H. cercidicola	+	+	(+)	·	·	·	southern
H. rubiginosum	+	+	+	·	·	·	southern
H. vogesiacum	(+)	+	+	·	·	·	southern
H. fuscum	+	+	+	(+)	(+)	·	southern
H. multiforme	+	+	+	+	+	·	widely distributed
H. salicicola	·	(+)	+	+	+	·	northern
H. macrosporum	·	·	·	+	+	+	northern

By far the largest group was the southern species (Tab. 5). Among those, *Hypoxylon fuscum* was specificly searched for on its primary host, *Corylus*, at an outpost site on Engeløya (No), but with a negative result. Its second most frequent host was *Alnus*, with the widely distributed *A. incana* as the common host. *H. fuscum* was nevertheless virtually absent from North Norway (Fig. 10), except for three records, the northernmost being of vegetative stromata on *Alnus* in the interior of Finnmark (70 °N, 27 °E). *Hypoxylon howeianum* with the same hosts as *H. fuscum* had an even more restricted distribution (Fig. 20), and ascomata from western Norway were mostly immature. The host-indifferent *Hypoxylon rubiginosum* (Fig. 34) was rare outside the nemoral and boreonemoral regions, though some of its hosts are common all over Norway. *Hypoxylon vogesiacum* (Fig. 45), mainly occurring on *Ulmus* and *Fraxinus*, was found in the boreonemoral and the southern boreal regions, just touching the nemoral region in southern Norway.

Hypoxylon macrosporum, restricted to *Salix*, is the most typical representative of the northern species (Fig. 21), occurring also in the low alpine region further south (Tab. 5). *H. salicicola*, likewise on *Salix*, was found in the boreal regions, and in southern Norway even in the boreonemoral region (Tab. 5). Its center of distribution, however, indicates affinity to the northern species (Fig. 35).

MORPHOLOGY

Characteristic features of the two species of sect. *Annulata*, *Hypoxylon cohaerens* and *H. multiforme*, were the conspicuous dark, carbonaceous tissue of the outer peridial layer, and ascospores with a small evagination or thickening in the perispore. A non-carbonaceous peridium was common to the species in sect. *Hypoxylon*. The ascospores of the species in the latter section had transversally striate perispores when investigated by SEM, except for *H. macrosporum* and *H. vogesiacum*, which had smooth perispores. Striae in the perispore are seen in our species only by SEM. *Hypoxylon porphyreum* (sect. *Hypoxylon*) was the only species with ascospores combining a striate perispore with a small evagination (Fig. 23).

Among the Norwegian species, the amyloid reaction in the ascus annulus did not vary much. An exception was *H. cohaerens* which did or did not react with blueing of the annulus, irrespective of pretreatment with KOH-solution or not. Some species had a reduced annulus, for instance *H. laschii* and *H. porphyreum*. Some authors have attached importance to the length of the ascus stipe to distinguish related species. This character proved to be highly variable and useful in determination only when considering the mean lengths. In water mounts the asci tended to expand and the stipes would stretch with time, making single measurements unreliable. Paraphyses showed some interspecific differences, but were in practice of minor use to distinguish species.

DISCUSSION

ECOLOGY

Saprobic types

From the studied species it seems evident that taxa with a narrow host preference (Tabs 2-3) also have a tendency to behave as primary saprobes (Tab. 1) with the capacity to sporulate on fairly fresh substrates. The opposite is true for taxa with wide host preferences, as indicated previously by Whalley (1985: 375). As a hypothesis I might postulate that the more a taxon is bound to a limited range of hosts, the stronger is its character of a primary saprobe or a weak parasite.

When considering preferences as to sporulating on either bark or wood, the most aggressive saprobes in this study were strongly connected to the one or the other type of substrate: *Hypoxylon fragiforme* and *H. cohaerens* occurring only on bark; *H. macrosporum* and *H. vogesiacum* occurring on wood (Tab. 4). Endophytes of *Hypoxylon* and other xylariaceous genera in healthy, living trees have long been known (cf. L. Petrini & O. Petrini 1985). The investigations of Chapela & Boddy (1988) demonstrated that *H. fragiforme* is a *latent* invader (that is: with an endophytic phase) of *Fagus sylvatica*, thus supporing my observations on its ecology (v.s.). The species develop rapidly only when a certain water deficiency has been reached in the wood (Chapela & Boddy 1988; cf. also Boddy & Griffith 1989, and Boddy 1992: 765). Consequently, early-emerging stromata of *H. fragiforme* are expected. Very probably the same factors control the production of ascomata in *H. cohaerens* too, another probable latent invader.

For the species producing ascomata on naked wood, the vigorous stromata of, for instance, *H. vogesiacum*, on drying, fresh wood, are impressive and strongly favour the conception of an early or latent invader. The preference for sporulation on one or the other type of substrate is probably a process involving the interactions of several physiological and environmental factors, including type of host tree. Chapela et al. (1990) demonstrated an 'eclosion mechanism' of *H. fragiforme* ascospores, by which the physiology of the host bark was of vital importance in establishing an infection by the ascospores. Such host recognition, mediated by chemical signals, has also been demonstrated in other ascomycetes (Stone & O. Petrini 1997).

My observations indicate a more vigorous growth of *H. fragiforme* when closely associated with *H. cohaerens*. The reason for this is not clear. However, interactions of some kind are probably involved, for instance by the production of growth-promoting substances. On the other hand, Shigo (1964) noticed that the presence of *H. cohaerens* (and *H. rubiginosum*) on beech terminated the growth of *Nectria* species causing beech bark disease.

Host choice

Host preference may serve as a guide to identification, and an indication where to search for future material. This applies at least to Norway, while on a world-wide scale the reports of several additional host species (cf. Miller 1961, Ju & Rogers 1996) complicate the picture of host choice. In general, the proclivity for a particular host species (or host genus) seems to be less distinct

when considering a larger distributional area. However, because of scanty information on host preference of these fungi in geographical areas outside Norden, we have not sufficient data to compare host preference or host frequency among different regions.

For the widely distributed *H. multiforme*, the exceptionally large number of collections, particularly on *Betula*, reflects the fact that birch is the preferred host and also the most common hardwood in Norway. In addition, the stromata of this species are easily seen. The frequency of *H. multiforme* on *Alnus* (of which 92% is on *A. incana*) accords with expectations, judging from the frequency of *Alnus* relative to *Betula*. On the other hand, in Norway *Sorbus* and *Prunus* are less frequent genera than either of *Salix* or *Betula*. Therefore, the relatively high frequency of *H. multiforme* on *Sorbus* and *Prunus* compared to *Salix* certainly reflects a real preference for the former. The wide range of hosts of *H. multiforme* and its distribution in a multitude of different habitats apparently all over the North Temperate Zone, emphasize its evolutionary success. A study of its physiology and genetics could reveal the bases for its success, and make *H. multiforme* a valuable reference organism in the study of ecology and the study of evolution of stromatic 'Pyrenomycetes'.

The host choice of *Hypoxylon fuscum* and *H. howeianum* may indicate that species with few hosts adhere to related hosts. However, this is not always the case. For example *H. vogesiacum* seems to be associated with *Ulmus* and *Fraxinus*, although these hosts do not even belong to the same subclass (Tab. 2). Nor can anything definite be said as to whether related fungal taxa tend to inhabit related hosts. A challenging question is why accessible hosts in an area do not fulfill the requirements for sporulation in some species with an otherwise wide host range. For instance, *Hypoxylon multiforme* has never been found on *Ulmus*, *Tilia* or *Fraxinus* in Norway, nor has *H. rubiginosum* been found on *Betula* or *Corylus*. Chemical composition of the woods may be a part of the explanation. The high tannin content in species of Fagales is well-known. This may favour species such as *H. multiforme*, or inhibit potentially competitor fungi.

The lack of records of stromata on coniferous woods is common to all known species of *Hypoxylon*. This characteristic indicates that the fungi either do not tolerate the various phenolic compounds in these woods in the ascomatal phase, or that they lack enzyme systems which can hydrolyze the hemicelluloses specific to conifers. Rogers (1979) argued that *Hypoxylon* spp. co-evolved with the rapidly developing angiosperms in seasonally dry areas during the late Mesozoic. This was questioned by L. Petrini & O. Petrini (1985) because of the endophytic presence of several species of *Hypoxylon* (incl. *Nemania*), and other xylariaceous genera, in both angiosperms, conifers, ferns, bryophytes, and lichens.

CHOROLOGY

An arrangement of the basidiomycetes of Norway in distributional groups (geoelements) was first made by Blytt (1905), and later developed and expanded by Eckblad (1981), who also included some ascomycetes. When the distribution in neighbouring areas (remaining Norden and Europe) is taken into account as well, such an arrangement may provide an important basis for hypothesis of factors causing the distribution.

An interesting group as regards distribution are the host genus-selective species (Tab. 3). Except for *Hypoxylon macrosporum* and *H. salicicola*, these belong to the southern geoelement.

Of these, *Hypoxylon fragiforme* is found in every site with a reasonably large stand of spontaneous or planted *Fagus sylvatica,* including the northernmost beech wood (probably planted) near Bergen (60° 38 'N). *H. cohaerens* occurs in the area of spontaneous *Fagus* in the boreonemoral region in southeastern Norway (Fig. 6). Although *H. cohaerens* has a slightly more eastern tendency than *H. fragiforme*, both fungi occur in the nemoral region in the remainder of Norden and in Europe, accompanying their largely nemoral host, *Fagus sylvatica*. Consequently we cannot easily judge which is the more important: host connection or physical regional parameters. However, the Norwegian distribution of *H. cohaerens* indicates a stronger dependence on regional (climatic) factors. Because *H. cohaerens* is mainly found in the boreonemoral region in Norway, with higher summer temperatures than in the nemoral region, this species may require a higher summer temperature than *H. fragiforme*.

Hypoxylon rubiginosum, *H. fuscum* and *H. howeianum* are more strongly restricted to particular vegetation regions than to the distribution areas of their hosts, indicating that regional factors are likely to be the more decisive. The same appears to be the case for *Hypoxylon porphyreum* (on *Quercus*), and *H. vogesiacum* (on *Ulmus* and *Fraxinus*), being more or less restricted to particular vegetation regions (Tab. 5). In addition, both of these species seem to avoid the outer coastal areas, and thus exhibit an eastern distributional trend. Although the eastern tendency *of H. vogesiacum* in Norway is not obvious, its occurrences in the boreonemoral exclaves in western Norway is an indication of this, as is its Nordic distribution (Granmo et al. 1989).

Hypoxylon vogesiacum is certainly more common in Norway (and Norden) than indicated on the map (Fig. 45). I have not had the opportunity to search for *H. vogesiacum* in interior southern Norway, and the apparent rarity of the species in that part of the country is most probably due to insufficient collecting there. On the other hand, its absence from the nemoral region in Norden seems real, in spite of the hosts being common there, too. Accordingly, an eastern subgroup of the southern geoelement in Norway is suggested, similar to Eckblad's (1981: 97, 106) 'southeastern species' for some terrestrial litter fungi. The southern species of *Hypoxylon* evidently have specific ecological demands to be fulfilled for sporophore development related to host species, but even more to the physical conditions of the southern vegetation regions. These may relate to climate, such as summer temperature, heat sum, or length of the growing season.

Species of the northern geoelement, likewise, has specific requirements not met with outside the vegetation regions in which these species occur. The distribution of northern species may be exemplified by the distribution of *Hypoxylon macrosporum* (Fig. 21). The high density of localities in Troms and in southern Nordland reflects the systematic collecting of G. Mathiassen in the 1980s (Mathiassen 1989, 1993). *H. macrosporum* is most frequent in the northern boreal and low alpine regions (Mathiassen 1993: 33, 95), and it has an eastern trend in Norway. Its overall distribution has been referred to as 'arctic-alpine' (Whalley & Knudsen 1985, Granmo et al. 1989). It seems, however, more correct to denote it 'boreal-montane', owing to its centre of distribution, which is obviously neither in the Arctic nor in the treeless alpine regions, but in boreal regions, with additional stations in mountainous areas.

The absence of *H. salicicola* (Fig. 35) from the northernmost county, Finnmark, is certainly due to insufficient collecting. Neither *H. macrosporum* nor *H. salicicola* have been searched for by the author near the treeline, or in the low alpine region, in southern Norway, where I suggest them to be not uncommon.

Thus, the arrangement of the pertinent species according to vegetation regions (Tab. 5) again seems more fundamental than their connection to the preferred host(s). This, of course, only

refers to records of the teleomorphs. At present nothing is known about the occurrence or influence of potential mycelia in various kinds of woods outside the area suitable for sporophore development.

MORPHOLOGY AND TAXONOMY

An extensive treatment of morphological features in *Hypoxylon* and their relevance in an evolutionary context is given by Ju & Rogers (1996), and a study of the rather few Norwegian species can add but very little to this.

The great plasticity of the stromatal forms has challenged all students of *Hypoxylon*. It is particularly evident in species such as *H. fuscum*, *H. multiforme* and *H. porphyreum*. The different forms are to a high degree correlated to the type of substrate. In general, when a species occurs on wood it tends to be effused or effused-pulvinate, while on bark it tends to assume a pulvinate to hemispherical form. The cause of this is not clear. However, the more delimited stromata on bark may simply result from mycelium in or beneath the bark developing stromatal initials which force themselves through the bark where it is least resistant. This will be the cork pores, where the initials might be influenced by light or excessive oxygen for further development. On wood there is no obstacle to the spread of stromata over the open surface. There are, however, exceptions to this rule. *Hypoxylon cercidicola* for example is effused on both bark and wood. *H. fragiforme*, *H. howeianum* and *H. cohaerens*, commonly found on bark, always retain their delimited form even when growing close to bare wood. They are as conservative in terms of stromatal forms as *Daldinia* or *Xylaria* species.

The carbonaceous tissue connected with the perithecial wall in *H. cohaerens* and *H. multiforme*, is in accordance with the observation of Ju & Rogers (1996), who found this characteristic to be common to all species of sect. *Annulata*. The origin of the carbonaceous layer is still not clear, but I suggest it to be of entostromatic origin. If this is the case, it is different from the origin of the carbonaceous peridial layer in the genus *Nemania*, which I believe is only an extension of the ectostroma. Ju & Rogers (1996) maintained that the carbonaceous tissue indicated relationship with a hypothetical *Biscogniauxia*-like ancestor particularly adapted to arid conditions. According to this view, sect. *Hypoxylon* is the more advanced, probably having evolved from sect. *Annulata*. Furthermore, they considered that sect. *Annulata* might merit the status of genus (Ju & Rogers 1996: 11). Their opinion has been strenghtened by the investigation of rDNA sequences of *Hypoxylon*, *Nemania* and *Entoleuca* performed by Granmo et al. (1999).

The usually dehiscent perispore of the ascopores is evidently the same as the W1 layer of the ascospore wall, as described and illustrated by Beckett (1975) in *Daldinia concentrica*. While *Hypoxylon porphyreum* is the only species in my study with both striate ascospore perispores and with a small evagination in the perispore, Ju & Rogers (1996: 34) refer some collections of the South-American *H. subrutilum* of sect. *Hypoxylon* with those characteristics.

As pointed out by L.E. Petrini et al. (1987), there may be a considerable variation in the size of ascospores among specimens of *Hypoxylon fuscum* growing on different hosts. I noticed the same in this species: specimens growing on *Alnus* had smaller ascospores than those on *Corylus*. We do not yet know if this indicates that genetically different forms have evolved with particular hosts. Difficulties in evaluating small differences between otherwise similar collections from

the predominant ascospore form and colour are more fundamental than small differences in dimension. DNA-techniques could be efficient to acquire a better understanding of how different substrates (host species) may influence on spore dimensions.

Three species of *Hypoxylon*, all in sect. *Hypoxylon*, are known from Norden but have yet to be recorded from Norway. These are *Hypoxylon investiens*, recently found in Finland, *H. julianii* in Denmark, and *H. macrocarpum*, known from Sweden and Denmark. One new taxon recently found in North Norway (A. Granmo, unpubl. data) remains to be fully studied and described. Considering the entire Europe, with a total of about 25 taxa of *Hypoxylon* s. str., six species and one variety remain so far unknown in Norden: *Hypoxylon ferrugineum*, *H. fraxinophilum* (= *H. intermedium* s. Ju & Rogers 1996, comb. illeg.), *H. moravicum*, *H. perforatum* (= *H. rubiginosum* var. *perforatum*), *H. rutilum*, *H. ticinense* and *H. cohaerens* var. *microsporum* (cf. L.E. Petrini & Müller 1986).

TAXONOMY

KEY TO THE SPECIES

1		Ostioles conspicuously papillate, ectostroma and outer part of perithecial wall carbonaceous (section *Annulata*) 2
1		Ostioles umbilicate, rarely papillate, ectostroma and outer perithecial wall not carbonaceous (section *Hypoxylon*) 3
2	(1)	Entostroma with black particles, ascospores 9-12.5 × 4-6 μm, germ slit of spore-length (host: *Fagus*) . . . . . *Hypoxylon cohaerens*
2		Entostroma lacking black particles, ascospores 8-11.5 × 3-5 μm, germ slit less than spore-length . . . . . *Hypoxylon multiforme*
3	(1)	Stromata globose, 0.3-1 cm diam. and 0.4-0.7 cm high 4
3		Stromata pulvinate to hemispherical, effused-pulvinate to effused 5
4	(3)	Ascospores 11-15 × 5-7 μm (host: *Fagus*) . . . . . *Hypoxylon fragiforme*
4		Ascospores 6.5-10.5 × 3-4.5 μm (hosts other than *Fagus*) *Hypoxylon howeianum*
5	(3)	Stromata pulvinate to nearly hemispherical and gregarious on bark, or rarely on wood and then effused-pulvinate to effused 6
5		Stromata effused and usually on wood, rarely somewhat pulvinate when on bark 8
6	(5)	Stromata emerging from bark, distinctly rough by perithecial elevations, often with reddish brown pruina, ascospores 8.5-11 × 3.5-5 μm (hosts: ornamental *Populus* spp.) . . . . . *Hypoxylon laschii*
6		Stromata not emerging, surface not rough, though often uneven, ascospores larger 7
7	(6)	Young stromata with brownish pruina, ascospores 10-16 × 4-8 μm, dark brown to brown, germ slit conspicuous, distinctly undulating (hosts: *Betulaceae*) *H. fuscum*
7		Young stromata with greyish or grey yellowish pruina, ascospores 10-13.5 × 4-5 μm, brown, germ slit straight or undulating (host: *Quercus*) . . . . *H. porphyreum*
8	(5)	Ascospores 15 μm or longer 9
8		Ascospores less than 15 μm long 11
9	(8)	Ascospores 15-18 × 6-8 μm, pale brown to brown, stromata with ruby red spots immediately beneath ectostroma and in entostroma (hosts: *Alnus*, *Salix*) (not yet recorded for Norway) . . . . . *H. julianii*
9		Ascospores 17-34 × 7-13.5 μm, brown, stromata lacking ruby red spots 10
10	(9)	Ascospores 17-28 × 7.5-12 μm, stromatal surface even (hosts: *Ulmus*, *Fraxinus*)

. . . . . *H. vogesiacum*

10 Ascospores 22-34 × 7-13.5 µm, stromatal surface distinctly rough from perithecial elevations (host: *Salix*) . . . . . *H. macrosporum*

11 (8) Stromata vinaceous brown to terra-cotta, ectostroma waxy, shiny (resinous), perithecia large, 0.5-1 mm high (not yet recorded for Norway) 12

11 Stromata brown, ectostroma not as above, perithecia small, 0.2-0.6 mm high 13

12 (11) Perithecia obovoid, wall angular due to compression, ascospores 9-13 × 3-5µm, inequilaterally ellipsoid with dehiscent perispore (hosts: *Fagus*, *Fraxinus*) (not yet recorded for Norway . . . . . *H. macrocarpum*

12 Perithecia long ovoid, ascospores 8-10 × 3.5-5 µm, ellipsoid with indehiscent perispore (host: *Populus tremula*) (not yet recorded for Norway) . *H. investiens*

13 (11) Perithecial elevations prominent, easily visible to the naked eye 14

13 Perithecial elevations faint or none, not visible to the naked eye 15

14 (13) Ascospores 9-12.5 × 4-6 µm, distinctly inequilaterally ellipsoid (several deciduous host trees) . . . . . *H. rubiginosum*

14 Ascospores 7-10 × 3-4.5 µm, only slightly inequilaterally ellipsoid (hosts: *Salix*, rarely *Prunus*) . . . . . *H. salicicola*

15 (13) Ascospores 9.5-13 × 4.5-6.5 µm, inequilaterally ellipsoid, brown with easily dehiscent perispore (host: *Fraxinus*) . . . . . *H. cercidicola*

15 Ascospores 10.5-12.5 × 5-6 µm, ellipsoid to ovoid, brown to dark brown, perispore dehiscent only in some spores (host: *Sorbus*) . . . . . *Hypoxylon* sp. (unpublished taxon)

DESCRIPTIONS OF SPECIES

Hypoxylon cercidicola (Peck) Y.-M. Ju & J.D. Rogers

Mycol. Mem. 20: 95 (1996) - *Diatrype cercidicola* Peck, A. Rep. N. Y. St. Mus. 25: 101 (1873) - *Anthostoma cercidicola* (Peck) Sacc., Syll. Fung. 1: 306 (1882) - *Hypoxylon rubiginosum* (Pers.: Fr.) Fr. var. *cercidicola* (Peck) L.E. Petrini, in L.E. Petrini & Müller, Mycol. helv. 1: 533 (1986). - Anamorph: *Virgariella* (L.E. Petrini & Müller 1986).

Figs 3 A-C, 5 (map), 12 (stroma), 36.

Description. *Stromata* 1-10 × 0.5-3 × 0.04-0.08 cm, effused, on bark or on wood, usually with steep borders and even surface with hardly perceptible perithecial elevations, in some places finely wrinkled. A thin pruina covers the surface. Young and mature stromata brownish ochre or greyish brown, later fawn brown or brown (8D3/E4, 7E4/E5), encircled by a dark border. *Ectostroma* without pruina 50-75 µm, red inside (very thin sections in LM). *Entostroma* immediately beneath ectostroma red orange, gradually being more brown towards the perithecial

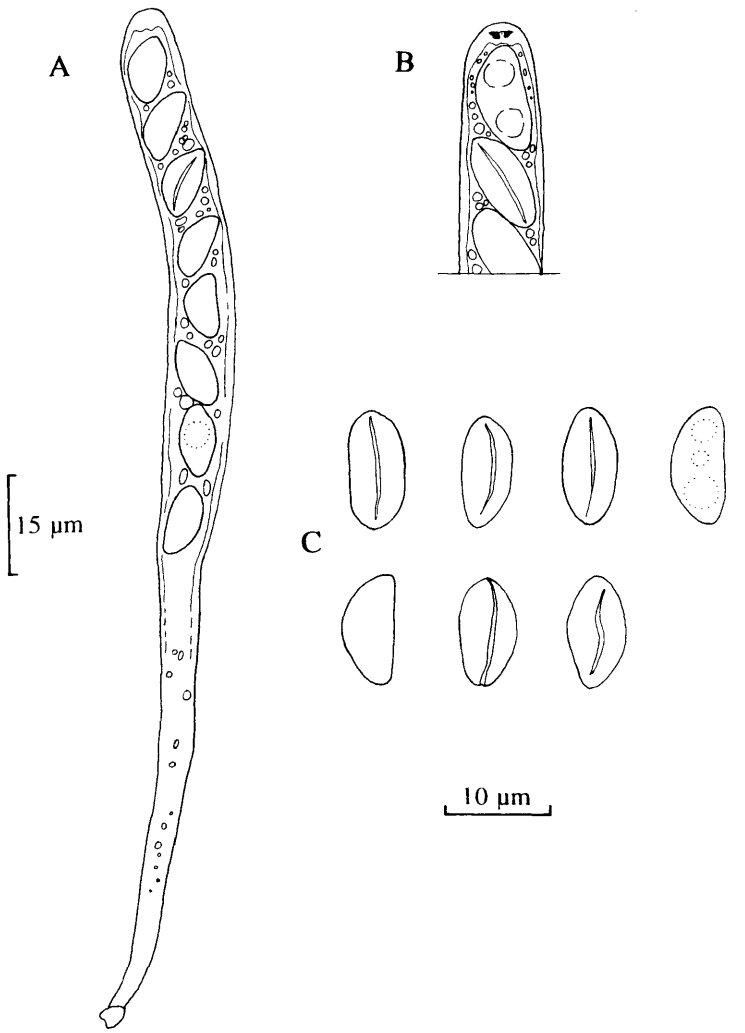


Fig. 3. *Hypoxylon cercidicola*. A. Ascus. B. Ascus apex in MZ. C. Ascospores. From TROM 75.

bases, where fungal tissue penetrates and carbonizes the host tissue and continues deep into the wood as black zones. *Perithecia* 300-510 µm high, 270-510 µm broad, m. 428 × 390 µm, subglobose, irregularly uniseriate, wall 30 µm. Ostioles umbilicate, often sunken in the stroma surface and with white mycelium in the pores. *Asci* p.sp. 65-92 × 7-9.5 µm, m. 79 × 8.2 µm, st. 49-76 µm, m. 62 µm, amyloid with discoid annulus 3-3.5 × 1 µm. *Paraphyses* ca. 300 µm long, 2-3 µm broad, septate, sparsely branched. *Ascospores* 9.5-13(-14.5) × 4.5-6.5 µm, m. 11.1 × 5.2 µm (n=133/7), inequilaterally ellipsoid, brown (6D6/E6), with dehiscent perispore, 1-2 guttules and a slightly undulating or sinuous germ slit the entire length of spore on convex side. *Pigments*

in 10% KOH: Ectostromal fragments liberate a yellowish brown (5C8/5D8) colour viewed with the naked eye. Granules of the pruina remain brown or yellow (LM) both in water and in KOH.

Taxonomic notes. Miller (1961) included *Hypoxylon cercidicola* (as *Diatrype c./Anthostoma c.*) in his concept of *H. rubiginosum*. Though Granmo (1977) commented on some large-spored specimens of *H. rubiginosum* on *Fraxinus*, neither he nor Granmo et al. (1989) separated it from *H. rubiginosum*. Ju & Rogers' (1996: 96) concept of this taxon evidently deviates from that of L.E. Petrini (L.E. Petrini & Müller 1986). The former authors synonymize *H. cercidicola* with *Hypoxylon moravicum* Pouzar (likewise on ash), and describe the stromata as 'erumpent, discoid, ...', which fits well with *H. moravicum* but not with *H. rubiginosum* var. *cercidicola* in Petrini's sense. Moreover, the anamorphs of these species should be different. For *H. cercidicola* it is *Virgariella* (v.s.), while *H. moravicum* should have *Hadrotrichum pyrenaicum* O. Petrini & Cand. (L.E. Petrini & Müller 1986), the latter being that indicated for *H. cercidicola* s. Ju & Rogers (1996). I have adopted L.E. Petrini's concept of *H. cercidicola*, based on her confirmation of some of my material. It certainly differs from *H. moravicum*.

Ecology. *Hypoxylon cercidicola* is hitherto recorded on corticated and decorticated *Fraxinus* only, on which Petrini-Klieber (1985: 75) especially noticed it from branch corners and at the base of trunks. Immature stromata with anamorph stage on wood may sometimes be seen sunk to 1.5 mm into the wood, the border of the wood delimiting it like steep walls.

Distribution. *Norway*. AA, Ro, Ho. *Hypoxylon cercidicola* is certainly not rare within the distributional area of *Fraxinus*. *Total*. Central and western Europe, North America. It is said to be cosmopolitan by L.E. Petrini & Müller (1986: 534).

Differentiation. *Hypoxylon cercidicola* differs from *H. rubiginosum* in its plain stromata almost destitute of any perithecial contours, and in its larger spores and somewhat shorter ascus stipes.

Comments. *Hypoxylon cercidicola* is new to Norway and Norden.

Specimens examined. Norway: AA: Arendal: Tromøy 9 Apr 1996 *Fraxinus*(w) J.L.F. (O 100). Birkenes: Bjorvatn 14 Jul 1995 *Fraxinus*(w) AG 167/95, 112/95 (TROM 89,90). Lillesand: Kvåse 15 Jul 1995 *Fraxinus*(w) AG 115/95 (TROM 92). - Ro: Suldal: Hylsfjorden Hylen 25 Jul 1994 *Fraxinus excelsior*(bw) AG 58/94, 51/94 (TROM 75,76). - Ho: Os: Hattvik 18 May 1973 *Fraxinus*(w) AG (BG 1). Granvin: Granvin hillside 500 m N of Eide railway st. 24 Jul 1994 *Fraxinus excelsior*(b,bw,w) AG 43/94, 44/94, 45/94 (TROM 86,74,78). Kvinnherad: Ølfernes N of the easternmost farm 24 May 1975 *Fraxinus*(b) J. Berge (BG 17).

Hypoxylon cohaerens (Pers.: Fr.) Fr.

Summa Veg. Scand. 2: 384 (1849) - *Sphaeria cohaerens* Pers.: Fr., Syst. Mycol. 2: 333 (1823); Pers., Römer's Neues Mag. Bot. 1: 82 (1794), Syn. Meth. Fung.: 11 (1801). - Anamorph: *Virgariella* (Jong & Rogers 1972; L.E. Petrini & Müller 1986).

Figs 4 A-D, 6 (map), 13 (stroma), 38.

Description. *Stromata* 0.2-0.4 cm in diam. and 0.2-0.3 cm high, pulvinate or turbinate with flattened top, erumpent from the bark in swarms and often coalescing, forming uneven crusts. Young, vegetative stromata greyish red, developing a soft, greyish brown to reddish brown, pulverulent covering or pruina, 30-50 μm thick; finally black, hard and brittle. *Ectostroma* without pruina 100-120 μm, woody, carbonaceous, brittle with age. *Entostroma* basal part ca. 1.5 mm, in young specimens greyish brown and woody with scattered, carbonaceous granules, in older specimens loose, almost powdery, red brown. *Perithecia* 530-700 μm high, 370-680 μm broad,

wall 40-70 μm including carbonaceous outer layer, globose or ovoid, uniseriate, slightly elevated in older stromata only. Ostioles conspicuously papillate. *Asci* p.sp. 63-97 × 6-7.5 μm, m. 75 × 6.8 μm, st. 60-110, m. 85 μm, amyloid or not in MZ, regardless of pretreatment with 2% KOH. *Para-*

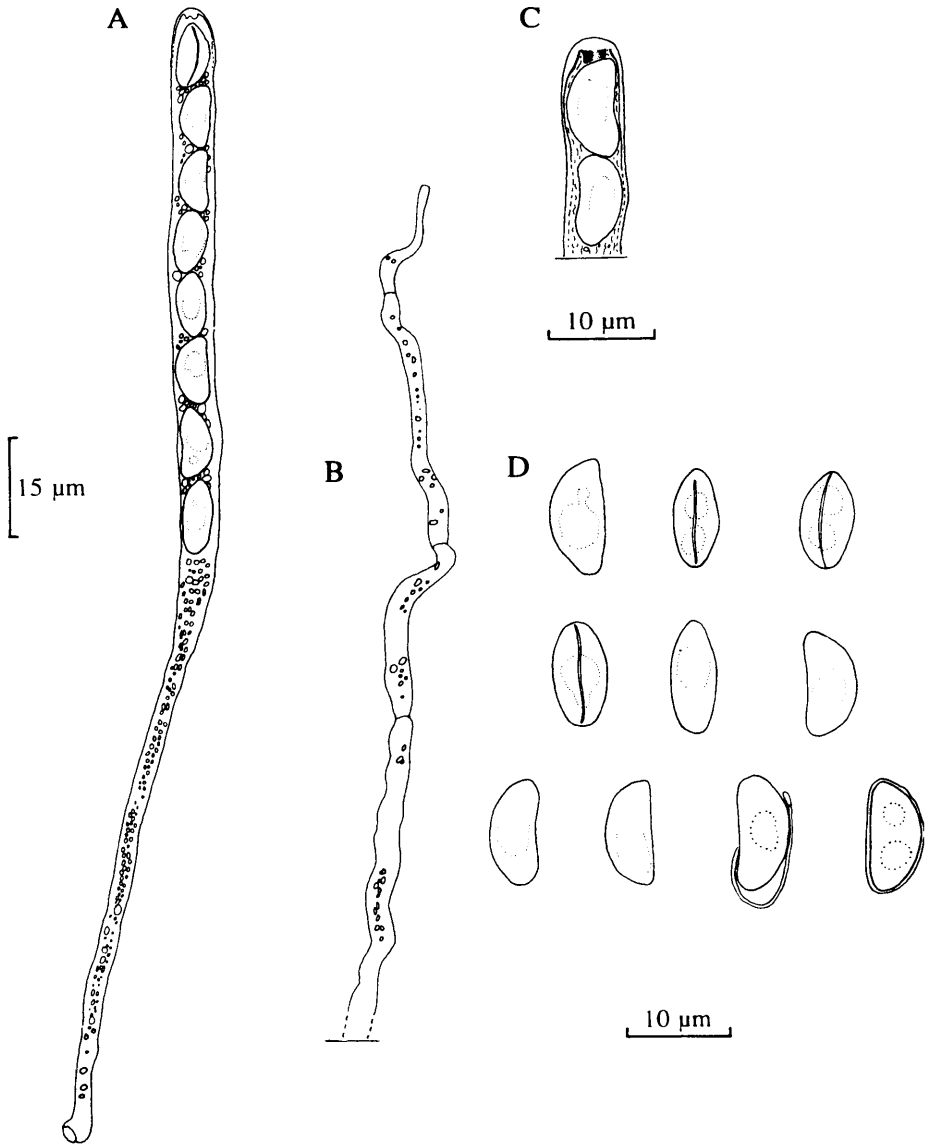
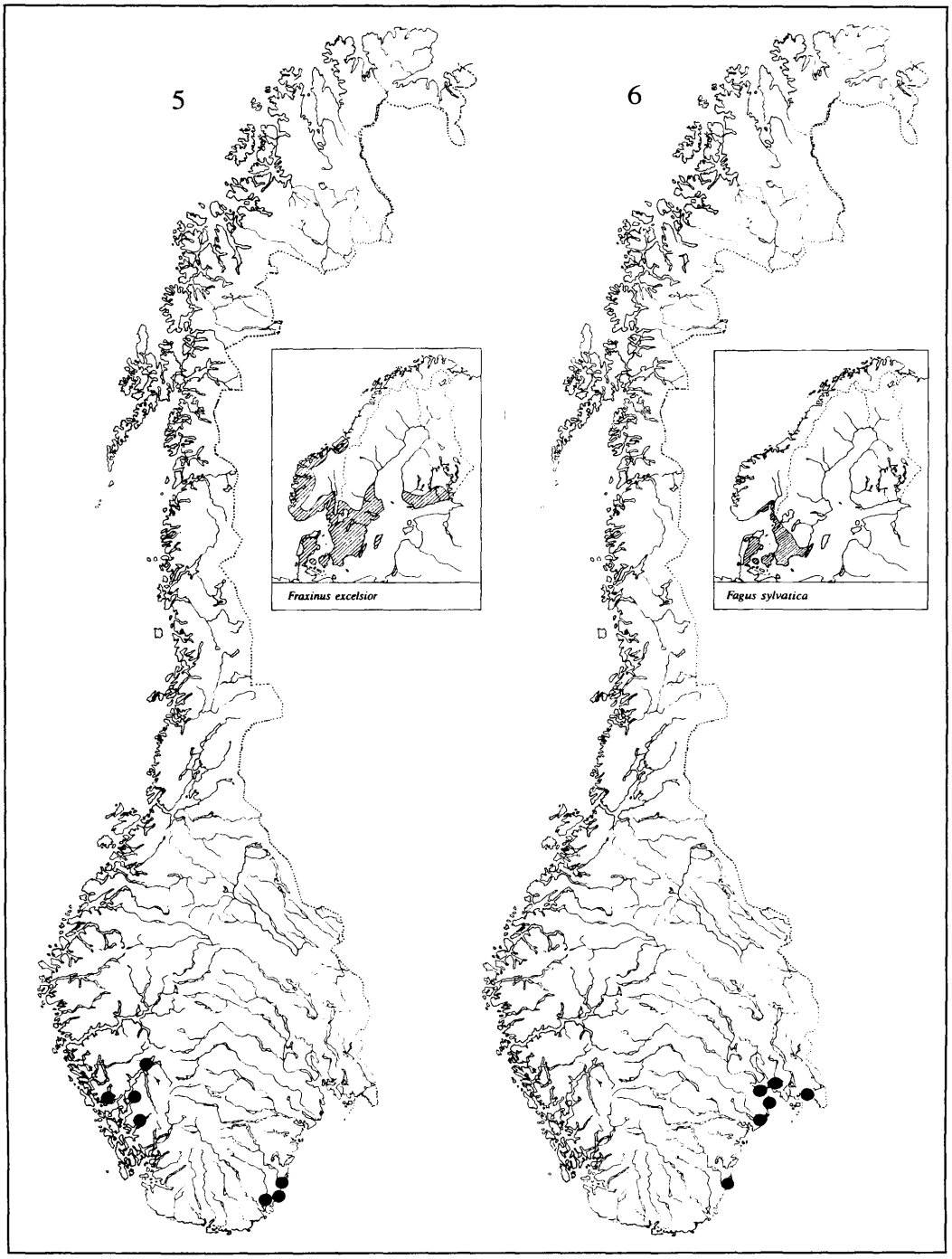


Fig. 4. *Hypoxylon cohaerens*. A. Ascus. B. Upper part of paraphysis. C. Ascus apex in MZ. D. Ascospores, of which the two last spores are drawn with perispore. Note small thickening in the perispore. A-C from TRH 2, D from TRH 2 and TROM 19 (the two spores bottom right).



Figs 5-6. Distribution in Norway. Fig. 5. *Hypoxylon cercidicola* and the Nordic distribution of its host. Fig. 6. *Hypoxylon cohaerens* and the Nordic distribution of its host.

physes 200-300 μm, 6 μm broad at base and 1.5 μm at top, constituting an entangled network mixed with copious slime. *Ascospores* 8-12.5(-13.5) × 4-6 μm, m. 10.1 × 4.7 μm (n=109/6), inequilaterally ellipsoid, hazel brown to rusty brown (6E7/E8, 7D7), with 1-2 guttules and easily dehiscent perispore with a small thickening toward one end. Germ slit the whole spore-length on convex side.

Taxonomic notes. From the Atlantic Pyrenees, France, Rogers & Candoussau (1980) described *Hypoxylon cohaerens* var. *microsporum* on *Quercus*, with spores only 6-9 × 3-4 μm (m. 7.1 × 3.2 μm sec. L.E. Petrini & Müller 1986). Soon afterwards it was recorded on *Quercus* in England (Cannon et al. 1985). The inamyloid ascus reaction in MZ in some specimens of *H. cohaerens* (including var. *microsporum*) has been noticed previously by various authors.

Ecology. *Hypoxylon cohaerens* is recorded on corticated, dead trunks and branches of *Fagus sylvatica*, the only host in Norway as well as in all Europe. In the U.S.A. it is also reported on *Fagus grandifolia* Ehrh., *Corylus* and *Quercus* (Farr et al. 1995). It is a primary saprobe which attacks quite fresh beech wood. I have sometimes seen it growing close to the stromata of *H. fragiforme*, in which case the latter seems to be especially large and stout.

Distribution. *Norway*. Ve, Øf, AA. *Hypoxylon cohaerens* is rare, and confined to the southeastern spontaneous occurrences of *Fagus* in Norway. *Total*. Sweden, Denmark; North Temperate Zone including Japan (Katumoto 1978).

Differentiation. *Hypoxylon cohaerens* is a characteristic species, but may be confused with the closely related *H. multiforme* when this occurs on *Fagus*. The more or less turbinate, aggregated stromata with dark particles in the entostroma will separate it from that species. The black stromata of *Melanamphora spiniferum* are of about the same size, and grow on the same host. The long ostioles and septate spores easily distinguish this species.

Comments. *Hypoxylon cohaerens* was recorded by Rostrup (1904: 19) from Ringebu (Op) ("Ringbo (Somft.) o. fl. St."). A specimen from Ringebu determined by S.C. Sommerfelt as *Sphaeria cohaerens* is *H. multiforme* on *Betula*. Another specimen from Larvik (Ve) was named *H. fuscum* by Rostrup, while it is in fact *H. cohaerens*.

Specimens examined. Norway: Øs: Halden: Remmendalen 9 Oct 1997 *Fagus*(b) s.n.c. (24542, TROM). Rygge: Kajalunden beech forest 1 Jan 1981 *Fagus*(b) Ø. Weholt (TROM 16). - Ve: Larvik: "Laurvig in Fago" s.d. *Fagus*(b) M.N. Blytt (O 3). Larvik 3 Sep 1879 *Fagus*(b) A. Blytt (O 4). Yttersø-Hedrum 4 Jan 1927 *Fagus*(b) O.A. Høeg (TRH 2). Larvik Beech Forest 22 Jun 1946 *Fagus*(b) F. Roll-Hansen (O 13), 29 Jul 1974 *Fagus*(b) AG 256/74, 267/74 (ass. with *H. fragiforme*), 271/74, 272/74 & s.no. (BG 7,12,5,8,6). Nøtterøy: Støyten 2 Nov 1982 *Fagus*(b) S. Aase (O 15). Tønsberg: Gullkronen at Jarlsberg estate 12 Oct 1978 *Fagus*(b) A.-E. Torkelsen 307/78 (O 14). - AA: Grimstad: Fevik the beech forest at Søm 20 Jul 1974 (ass. with *H. fragiforme*) *Fagus*(b) AG 126/74, 127/74, 128b/74; 120/74 (BG 9,10,11; s.no.), 12 Jul 1995 *Fagus*(b) AG 77/95, 78/95, 79/95, 80/95, 90/95 (TROM 17,18,19,29,21). **Sweden:** Småland: Femsjö Dullaberget 15 Aug 1929 *Fagus sylvatica*(b) J.A. Nannfeldt 2447 (BG 1). Uppland: Harg par. Fagerön 3 May 1998 trunk of fallen (planted) *Fagus sylvatica*(b) K. & L. Holm (priv. coll.).

Hypoxylon fragiforme (Pers.: Fr.) J. Kickx f.

Fl. Crypt. Env. Louv.: 116 (1835) - *Sphaeria fragiformis* Pers.: Fr., Syst. Mycol. 2: 332 (1823); Pers., Usteri's Neue Annln Bot. 5: 21 (no. 26) & Pl. 2, Fig. 5 (1794), Syn. Meth. Fung.: 9 (1801) - *Peripherostoma fragiformis* (Pers.: Fr.) Gray, Nat. Arr. Br. Pl. 1: 513 (1821) - *Valsa fragiformis* Scop., Fl. Carn. 2: 399 (1772) - *Hypoxylon coccineum* Bull., Hist. Champ. Fr. 1: 174, Pl. 495, Fig. 2 (1791) - *Hypoxylon argillaceum* (Fr.: Fr.) J. Kickx f., Fl. Crypt. Env. Louv.: 116 (1835), non (Pers.) Nitschke (1867). - Anamorph: *Nodulisporium* (Greenhalgh & Chesters 1968, L.E. Petrini & Müller 1986).

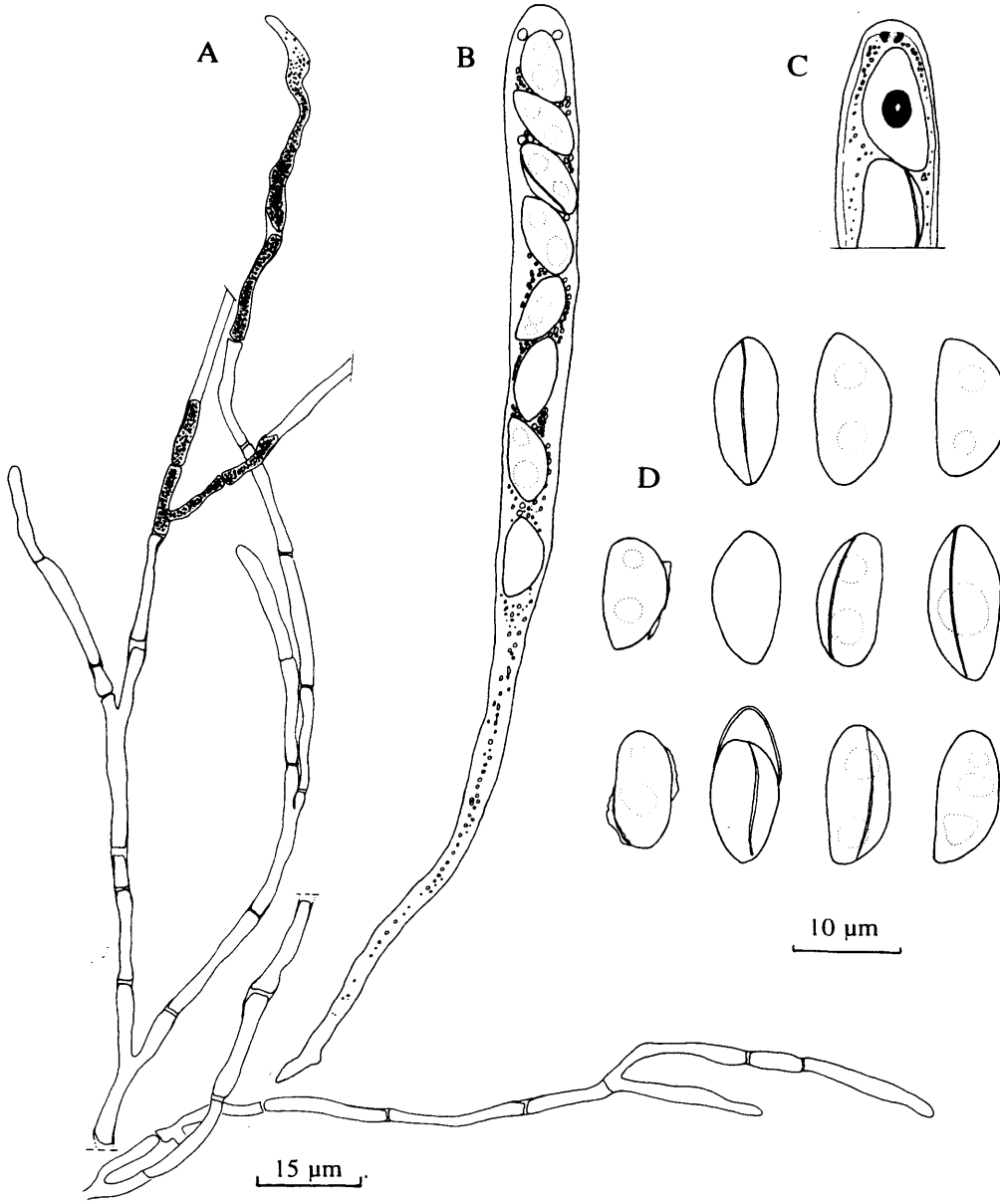


Fig. 7. *Hypoxylon fragiforme*. A. Paraphysis, upper and lower (bottom) parts. B. Ascus. C. Ascus apex in MZ. D. Ascospores, the third from the right in the bottom row with adherent part of perispore. From O 5.

Figs 7 A-D, 9 (map), 14 (stroma), 50 (SEM).

Description. *Stromata* 0.3-1 cm diam., 0.3-0.7 cm high, globose to subglobose, in groups on bark. Mostly well separated but occasionally coalescing, attaining up to 3 × 1 × 1 cm. Young stromata brick red to brownish red, often with a grey or yellowish brown pruina to 120 μm thick, at times with a greenish mycelial web. Stromal surface becomes distinctly roughened with age due to maturing perithecia. Old stromata bronze to dark brown, often with ectostroma peeling off. *Ectostroma* of young stromata ca. 100 μm exclusive of pruina, waxy, shiny, consisting of an outer brownish tissue with an inner orange to red stratum, which often extends in between and beneath the perithecia as thin, red stripes. *Entostroma* basal part 2-3 mm, soft woody, dark brown. *Perithecia* 500-700 μm high, 450-500 μm broad, wall 20-25 μm, bottle-shaped or ovoid, uniseriate, occasionally biseriate. Ostioles umbilicate, canal ca. 120 μm long. *Asci* p.sp. 75-97 × 8-10(-11) μm, m. 85 × 9.1 μm, st. (34-)50-110 μm, m. 68 μm, amyloid with discoid annulus 2.5 × 1.5 μm. Asci in fascicles on the ascogenous hyphae. *Paraphyses* to 300 μm long, 2.5-4 μm broad, septate, considerably branched, partly with yellow contents. *Ascospores* 11-15(-16) × 5-7 μm, m. 12.6 × 5.8 μm (n=160/8), inequilaterally ellipsoid, 1-2(-3) guttules, dark brown. Perispore dehiscent, finely transversally striate (SEM). Germ slit distinct, the entire length of the spore on the convex side.

Taxonomic notes. *Hypoxylon fragiforme* is the type species of both the genus and the section *Hypoxylon*. Fries (1849) named it *Hypoxylon coccineum* in his revised genus *Hypoxylon*, the name commonly used until Miller (1932:137) suggested the correct name. Sources citing *H. coccineum*, at any rate before Miller, must be regarded as possibly including *H. howeianum*. Scopoli's *Valsa fragiformis* was cited as a synonym both by Tulasne & Tulasne (1863) and Nitschke (1867), but not by Fries (1823) nor by Persoon (1794). It was used as basionym by Cannon et al. (1985) and by Chlebicki (1990), which in my opinion is untenable because nothing links Scopoli's name with Fries' sanctioned name. Martin (1969: 199) synonymized *Sphaeria coccinea* Hooker with *H. fragiforme*. Ostensibly this also applies to that *S. coccinea* published by, among others, Sommerfelt (1826) on *Alnus* in Saltdalen (No). Sommerfelt's description has nothing to do with *Hypoxylon*, but treats the common *Nectria episphaeria* (sec. Jørstad 1928: 442).

Ecology. *Hypoxylon fragiforme* occurs on corticated trunks and branches of *Fagus sylvatica*, the common host wherever found. It may well develop in fresh wood, and thereby induces a white rot. Granmo et al. (1989) recorded only 3 out of 85 Nordic collections on *Betula*, *Carpinus* and *Quercus* respectively, while all the rest were on *Fagus*. Recently it was found on *Alnus glutinosa* in Denmark by T. Læssøe (pers. comm.), which nearly completes the host range for all Europe. Norwegian material of the species is often immature and has relatively small stromata.

Distribution. *Norway*. Ve, AA, VA, Ro, Ho. *Hypoxylon fragiforme* is found in planted as well as in natural beech woods, extending to the northernmost stand of *Fagus* in Norway, Seim in Lindås (Ho) (60° 38 'N, 5° 16 'E). *Total*. Denmark, Sweden; nemoral Europe, North America, Russia, Japan (Katumoto 1978), China. Miller (1961) also claimed its occurrence in the Subtropics and in the South Temperate Zone.

Differentiation. *H. fragiforme* is easily recognized. The spherical, brown red stromata with slightly protruding perithecia have been compared with small strawberries. Confusion can only occur with *H. howeianum*, but this species has smaller spores and perithecia, a less rough surface and is recorded on deciduous trees other than beech.

Comments. *Hypoxylon fragiforme* was reported by Rostrup (1904, as *H. coccineum* Bull.)

from "Larvik o. fl. St.". There are two specimens of *H. fragiforme* previous to 1904 from the Larvik area (Ve), both collected by A. Blytt (O), and identified by Rostrup as *H. coccineum* Bull. and *H. fuscum*, respectively. Hennings (1904) noted *H. coccineum* on hazel from Oslo, which in all probability is *H. howeianum*. Later *H. fragiforme* was noted from Norway by Lange (1964), Granmo (1977) and Granmo et al. (1989).

Specimens examined. Norway: Øs: Halden: Remmendalen 9 Oct 1997 *Fagus*(b) s.n.c. 24544 (ass. with *H. multiforme*) (TROM). - Ve: Borre: Borre church 28 Oct 1977 *Fagus sylvatica*(b) A.-E. Torkelsen 985/77 (O 21). Larvik: Jordfalddalen 5 Sep 1879 (imm. stromata) *Fagus*(b) A. Blytt (O 20) (Rostrup 1904: 19 as *H. coccineum* Bull). "Jarlsberg og Laurvig amts bøgeskove" Sep 1883 *Fagus*(b) A. Blytt (O 6). Larvik May 1943 *Fagus*(b) T. Dyring (O 7). Larvik Beech Forest 25 Oct 1960 *Fagus*(b) F.-E. Eckblad (O 5), 28-29 Jul 1974 *Fagus*(b) AG 253/74, 260/74, 265/74 (BG 8,10,9). Tønsberg: Gullkronen at Jarlsberg estate 12 Oct *Fagus sylvatica*(b) A.-E. Torkelsen 288/78 (O 22), 24 May 1981 *Fagus sylvatica* P. Marstad (O 23). - AA: Grimstad: Fevik in the beech forest at Søm 20 Jul 1974 *Fagus*(b) AG 128a/74 (ass. with *H. cohaerens*), 129/74, 134-136/74 (BG 14,13,15). Fevik Søm 12 Jul 1995 *Fagus sylvatica*(b) AG 86/95, 87/95 (TROM 25,26). - VA: Farsund: Gaupeland 20 Jul 1995 *Fagus sylvatica*(b) AG 164/95 (TROM 27). - Ro: Hjelmeland: Årdal Melsåsen at Riskadalsvann 31 Jul 1969 (sterile) *Fagus*(b) L. Ryvarden (O 1). Stavanger: Gauselskogen 22 jun 1976 *Fagus*(b) S. Bakkevig (BG 19). - Ho: Lindås: Seim Vollom in the beech forest 17 Sep 1974 *Fagus*(b) E. Jensson (BG 16), 17 Sep 1974 *Fagus*(b) AG (BG 17), 25 Jan 1975 *Fagus*(b) AG 1/75, 4/75 (BG 11,12), 15 Sep 1984 *Fagus*(b) B.F. Moen (BG 24). **Sweden:** Småland: Femsjö N of Hylteberg 19 Jul 1929 *Fagus sylvatica*(b) J.A. Nannfeldt 3105 (BG 3). **Denmark:** Sjælland: København Dyrehaven 22 Jun 1995 *Fagus sylvatica*(b) AG (TROM 28). Lillerød Tokkekjøb hegn 15 Oct 1965 O. Skifte (TROM). Sorø Bromme Lillesø 21 Aug 1973 *Fagus sylvatica*(b) AG (BG 18). South Jylland: Åbenrå, Bolderslev Skov 1 Oct 1996 *Alnus glutinosa*(b) T. Læssøe 4359 (C, TROM). **Germany:** Schleswig-Holstein: Kiel 15 Jun 1973 *Fagus sylvatica*(b) AG (BG 4). Süd-Westfalen: Sauerland Rhonardberg bei Olpe am Biggesee ca. 450m alt. 2 sep 1971 *Fagus*(b) (ass. with *Nectria episphaeria*) P. Döbbeler 1464 (BG, dupl. ex herb. Döbbeler).

Hypoxylon fuscum (Pers.: Fr.) Fr.

Summa Veg. Scand. 2: 384 (1849) - *Sphaeria fusca* Pers.: Fr., Syst. Mycol. 2: 332 (1823); Pers., Usteri's Neue Annln Bot. 5: 22 (no. 27) & Pl. 2, Fig. 3 (1794), Syn. Meth. Fung.: 12 (1801) - *Hypoxylon purpureum* Nitschke, Pyren. Germ.: 37 (1867). - Anamorph: *Virgariella* (Greenhalgh & Chesters 1968, Jong &Rogers 1972, L.E. Petrini &Müller 1986).

Figs 8 A-D, 10 (map),15-16 (stromata), 39; 51 (SEM).

Description. *Stromata* on bark 0.2-0.7 × 0.2-0.5 × 0.1-0.3 cm, pulvinate to conical or hemispherical, singly or in groups, sometimes coalescing, on wood effused to effused-pulvinate, 0.5-8 × 0.2-3 × 0.1- 0.3 cm, surface usually even. Young stromata are covered with a thin, brownish pruina. Stromatal colours vary from brown to purplish: red brown (8D4), greyish brown (8E3/E4, 9F3), brownish grey (10F2), violet-brown (11E7/F7), or burgundy (12F5). A purplish shade (12F8/13F8) is often striking. *Ectostroma* without pruina 100 μm, waxy, the outermost brown layer, 20-30 μm, covering an inner red or reddish brown layer, 60-80 μm. *Entostroma* basal part 0.1-2.5 mm, brown, firm, in pulvinate stromata with a yellowish basal core. *Perithecia* 250-450 μm high, 220-360 μm broad, wall 35-45 μm, globose to ovoid, 1-2(-3) seriate, immersed or slightly elevated. Ostioles umbilicate. *Asci* p.sp. (54-)60-112 × 7-12 μm, m. 83 × 8.5 μm, st. (20-) 30-95(-145) μm, m. 56 μm, amyloid with discoid annulus 2-3 × 0.5-1.5 μm, frequently with only 7 obliquely uniseriate spores. *Paraphyses* 120-250 × 3-4 μm, septate, unbranched or sparsely branched, with yellow guttules. *Ascospores* (9-)10-16(-17) × 4-8 μm, m. 12.5 × 5.6 μm (n=1650/55), inequilaterally ellipsoid with narrow ends, brown to dark brown, transversally striate (SEM), with hyaline, dehiscent perispore and 1-2(-3) guttules. The perispore usually ruptures about one third of the spore-length from the distal, broader end of the spore. Germ slit distinct,

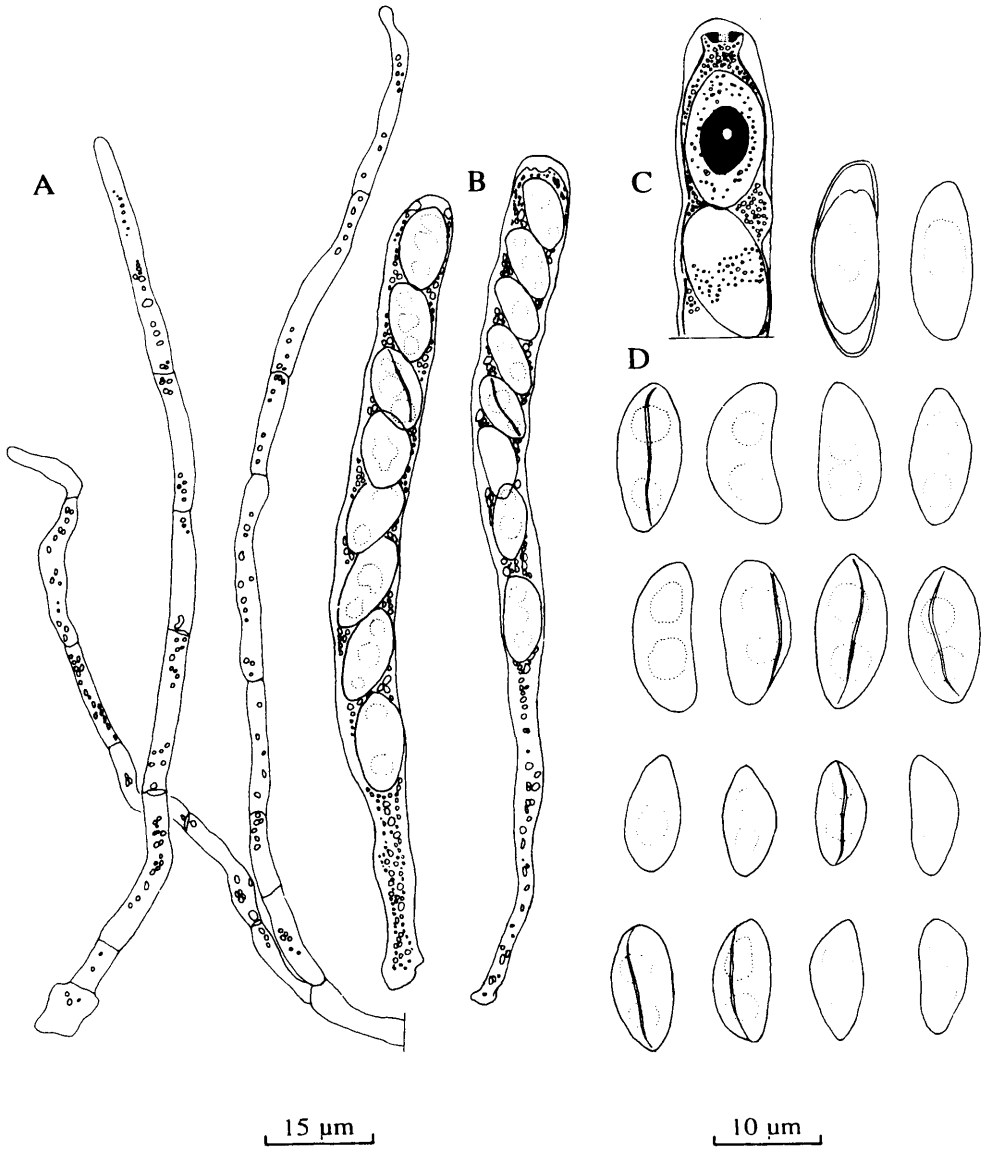


Fig. 8. *Hypoxylon fuscum*. A. Paraphyses, one unbranched and the upper part of another, branched (from BG 48). B. Asci from specimen on *Corylus*, left (BG 48), and on *Alnus*, right (O 29). C. Ascus apex in MZ (BG 48). D. Ascospores. The three uppermost rows are from specimens on *Corylus*; the upper left spore is releasing its perispore. The spores in the two lowermost rows are from specimens on *Alnus*.

strong, full length of spore on convex side, in a large proportion of spores characteristically undulating. *Pigments* in 10% KOH: Fragments of outer part of stroma brown yellow with greenish tone (4C8).

Taxonomic notes. Nitschke's *Hypoxylon purpureum* (Nitschke 1867) as judged from his voucher specimens (B), is partly *H. fuscum*, partly *H. rubiginosum*. In order to maintain current opinion the specimen corresponding to *H. fuscum* is selected for lectotype. Ju &Rogers (1996: 122) adobt a broad concept of the species. They indicate that further studies may motivate a subdivision.

Ecology. *Hypoxylon fuscum* is a common stromatic ascomycete in Norway on dead corticate, or at times decorticated, branches and trunks of *Corylus avellana*. *Alnus incana* is next in host frequency, followed by *A. glutinosa*, *Betula*, *Prunus padus* and *Carpinus betulus*. In Norden it is also recorded on *Acer*, *Populus* and *Sorbus*. Additional European hosts are *Crataegus*, *Fagus*, *Fraxinus*, *Robinia*, but *Corylus* is the primary host. Young mature stromata of *H. fuscum* are very common in the dry upper parts of broken, still standing stems of young hazels, 0.5-1 m above the ground. On *Alnus* it may associate with *H. multiforme*.

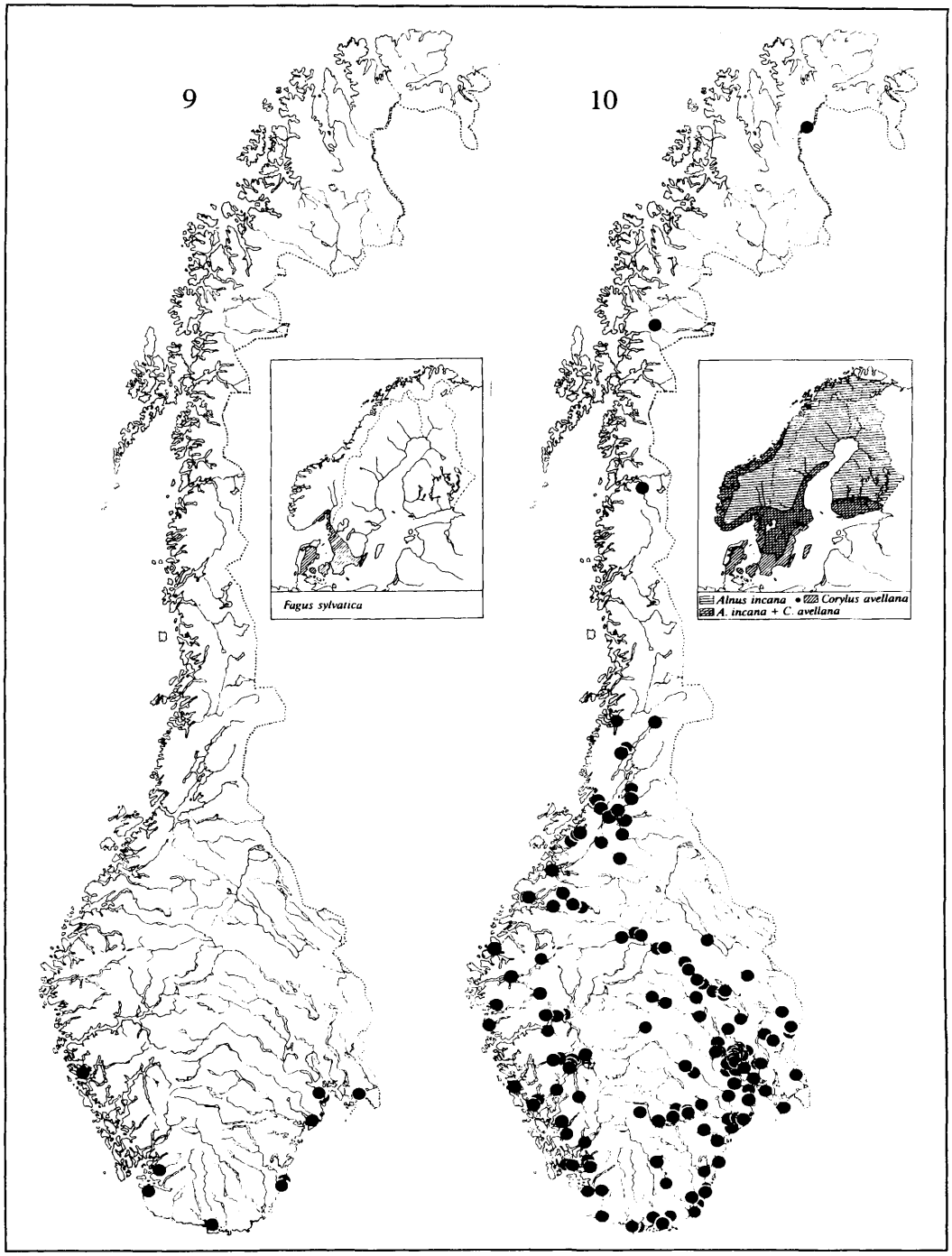
Distribution. *Norway*. *Hypoxylon fuscum* is recorded from all provinces, although it is very rare in North Norway. It has quite recently been found in Troms. The northernmost locality is Tana (Fi) (69° 55 'N, 26° 55 'E), in the northern boreal region, from which there are only a few finds from any Nordic country (Granmo et al. 1989). *Total*. It is a common fungus in the Temperate Zone in the northern hemisphere, recorded from all Europe and the former USSR (Bondarceva 1975); North America, Guyana, Japan, Philippines, Taiwan (Ju & Rogers 1996); China (Teng 1996). It is also said to occur in South Africa (Martin 1969).

Differentiation. *Hypoxylon fuscum* may at times be confused with *H. rubiginosum*. Although effused forms of *H. fuscum* on naked wood are ordinarily much more variable in stroma thickness, and with the surface lacking perithecial contours, one may also find forms very similar to *H. rubiginosum*. The larger spores with an undulating germ slit will indicate *H. fuscum*. For sterile stromata the difference in KOH-extractable pigments will be of help, as noted by Pouzar (1978: 21). The soft ectostroma of *H. fuscum* is also different from the carbonaceous ectostroma of *H. multiforme*.

Comments. The first Norwegian record of *Hypoxylon fuscum* (as *Sphaeria fusca*) was made by Sommerfelt from Saltdalen (No). He denoted it as rare there. The species was further commented upon by Trail (1889), Rostrup (1904), Størmer (1938), Granmo (1977), Granmo et al. (1989). Hungnes (1982) recorded it once on *Quercus*, but the wood is in fact *Corylus* (O 272).

The Norwegian collections of *Hypoxylon fuscum* may be arranged in two groups depending on spore size. When occurring on *Alnus incana* the ascospores are (9-)9.7-14.6 × 4-7 μm, m. 11.9 × 5.3 μm (n=410/26), while specimens on *Corylus* measure (10-)11-16(-17) × 4.5-7.5(-8.5) μm, m. 13.5 × 5.9 μm (n=594/24). Collections on some other hosts have intermediate spore sizes. There seems to be no other safe characters correlated with these spore-size groups, and all are considered within the limit of *H. fuscum*. L.E. Petrini et al. (1987) reached the same conclusion in their work.

Specimens examined. Norway: S.l.d.n.c. 9 coll. *Corylus*(b) (O 11,12,16,17,20), *Carpinus betulus*(b) (O 14), *Alnus*(b) (O 18), *Betula*(w) as *H. crustaceum* (Sow.) Nke. det. Rostrup, *H. rubiginosum* Pers. det. C.L. Shear 1923 (O 59). - Øs: Askim: Above upper Korngarden 8 Jun 1933 *Alnus*(b) A. Hagen (O 241). Hobøl: Tomter 18 Jun 1972 *Corylus*(b) A.-E. Torkelsen 237/72 (O 53). Hvaler: Søndre Sandøy 26 Apr 1975 *Alnus*(b) K. Høiland (BG 203). Marker: S of Øymarksjøen near Flaggberget 21 May 1934 *Alnus*(b) A. Hagen (O 42). Råde: Tomb agricultural school 4 Jul 1973 *Corylus*(b) L. Ryvarden 11915 (O 242). - Ak: Asker: Løknes 29 Sep 1879 *Corylus*(b) F. Hjort (O 113). Skaugumåsen 9 May 1923 *Corylus*(b) O.A. Høeg (O 116). Semsvik 2 May 1932 *Corylus*(b) O.A.



Figs 9-10. Distribution in Norway. Fig. 9. *Hypoxylon fragiforme* and the Nordic distribution of its host. Fig. 10. *Hypoxylon fuscum* and the Nordic distribution of its two most frequent hosts.

Høeg (TRH 130,133), 5 Jun 1971 *Corylus*(b) A.-E. Torkelsen (O 246). Hagahogget 22 Oct 1943 *Corylus*(b) F. Roll-Hansen (O 127). Heggedal Vardåsen 23 Apr 1972 *Corylus*(b) A.-E. Torkelsen 10/72 (O 55). Semsvatnet Tveter farm 21 Nov 1993 *Corylus avellana*(w) AG (TROM 266). Aurskog-Høland: Bjørkelangen 14 Sep 1974 *Alnus*(b) E. Fremstad (BG 170). Bærum: Bjerke Nov 1826 *Corylus*(b) S.C. Sommerfelt (O 129). Lysaker May 1850 *Corylus*(b) A. Blytt (O 120). Kjensrudtjern 27 May 1879 *Alnus*(b) A. Blytt (O 128). Overlandselven 30 Sep 1879 *Corylus*(b) A. Blytt (O 124). Tanumuren 6 May 1880 *Alnus*(w) & *Betula*(b) A. Blytt (O 119,70). Bærum 18 May 1884 *Corylus*(b) F. Werenskiold (O 123), 22 May 1893 *Alnus*(b) A. Blytt (O 118). Haslum 28 May 1933 *Corylus*(b) A. Hagen (O 112). Kolsås 15 Apr 1945 *Betula* F.-E. Eckblad (O 66). Jar 7 Jun 1962 *Corylus*(b) J.A. Nannfeldt (O 111). Eikeli 20 Nov 1966 *Corylus*(b) T. Schumacher (BG 214). Isidalen 25 Aug 1967 P.M. Jørgensen (BG 189). Frogn: Håøya Ravneflauget 27 Jul 1933 *Corylus*(b) P. Størmer (O 126) (Størmer 1938: 105). Håøya above the southern point 29 Jul 1934 *Corylus*(b) P. Størmer (O 114), 4 May 1991 A.-E. Torkelsen 19/91 (O 245). Nannestad: Tømte 9 Sep 1934 *Alnus*(b) A. Hagen (O 122), 13 May 1973 *Alnus*(b) G. Gulden 611/73 (O 57), 11 Sep 1974 *Alnus incana*(b) AG (BG 172). Nesodden: Nesoddtangen May 1944 *Corylus*(b) F.-E. Eckblad (O 121). Ski: Oppsahn 22 Apr 1973 *Alnus*(b) J. Stordal 15061 (O 236). Sørum: Kurland at Staurhaugen 14 Sep 1974 *Alnus*(b) AG (BG 171). Vestby: Son 11 Sep 1966 T. Elstrand (O 115). Åmot farm 28 Apr 1976 *Corylus avellana*(b) A.-E. Torkelsen 348/76 (O 243). Ås: Ås Jun and Nov 1885 *Alnus*(bw) F. Werenskiold (O 125). - Oslo: Oslo s.d.n.c. 6 coll. *Betula*(w) & *Alnus*(b) (O 45,97), *Corylus*(b) (O 90,93,96,104), s.d. *Corylus*(b) (101) M.N. Blytt (O 52,101), s.d. *Alnus incana*(b) F. Kiær 29 (O 87), 1849 *Corylus*(b) J.M. Normann (O 103), 1871 N.G. Moe (O 248), 1871 *Corylus*(b) N.G. Moe (O 100,102). Abbediengen s.d.n.c. *Corylus*(b) (O 110). Bogerud 7 Oct 1928 *Alnus incana*(b) I. Jørstad (O 85). Bygdøy (Ladegårdsøen) s.d.n.c. *Alnus*(b) (O 109). Høybråten 8 Aug 1963 *Alnus*(b) I. Egeland & G. Gulden (O 249). Maridalen chapel 23 Aug 1973 *Corylus avellana*(b) L. Ryvarden 12225 (O 247). Mærradalen s.d.n.c. (O 13), s.d. *Corylus*(b) (O 95, TRH 131), *Alnus*(b) (O 94), 16 Oct 1955 I.A. Pedersen (O 244). Nøkkvann near Lutdalen 5 Jun 1927 *Corylus*(b) I. Jørstad (O 91). Skøyen 1840 *Alnus*(b) M.N. Blytt (O 108). Skådalen Nov 1878 *Alnus*(b) A. Blytt (O 88), 1 Nov 1878 *Corylus*(b) A. Blytt (O 89). Tøyen 1840 *Corylus*(b), *Alnus*(b) N.G. Moe (O 86,98). Ullern s.d.n.c. *Corylus*(b) (O 92a. TRH 132). Ullernåsen Apr 1933 J. Thomle *Corylus*(b) (O 99). Østensjø 13 Oct 1878 *Alnus*(b) A. Blytt (O 105). - He: Eidskog: N-end of Stangnessjøen in Vestmarka 21 Jun 1964 *Alnus*(b) F.-E. Eckblad (O 40). SW-side of Skjervangen 5 May 1974 *Alnus incana*(b) A.-E. Torkelsen 529/74 (O 250). Elverum: Elverum Bronkeberget May 1942 *Alnus glutinosa*(b) O. Furuset (O 32). Ringsaker: Gjestvang 8 May 1975 *Corylus*(b) J. Stordal 16463, 16467,16476 (O 252a-c). Helgøya between Skavang and Grimsrud 1 May 1977 *Prunus padus* (b) J. Stordal 18163 (O 233), *Alnus incana*(b) J. Stordal 18146, 18157 (O 253a-b). Helgøya Hovinsholm 2 Oct 1977 *Alnus incana*(b), *Corylus avellana*(bw) A.-E. Torkelsen 787/77,788/77 (O 251,262). Stor-Elvdal: Evenstad Aug-Sep 1882 *Alnus incana*(b) A. Blytt (O 33), Jun 1884 *Alnus incana*(b) A. Blytt (O 34). - Op: Etnedal: Bruflat s.d.n.c. *Alnus*(b) (O 22). Fron: Above Harpefoss 2 Jun 1965 *Alnus incana*(b) F.-E. Eckblad (O 29). Gjøvik: Biri Svenes Aug 1923 *Prunus padus*(b) B. Lynge (O 31). Skistua 12 Nov 1973 *Alnus*(b) J. Stordal 15310 (O 232). Redalen Roli farm 18 Apr 1975 *Corylus*(b) J. Stordal 16261 (O 240). Biri NW of Svennes farm 10 May 1975 *Corylus avellana*(b) J. Stordal 16505 (O 285). Biri Honne 24 May 1975 *Corylus*(b) A.-E. Torkelsen 91/75 (O 255). Lillehammer: Fåberg Nordre Jørstad on the gravel island in Gausa 30 Apr 1950 *Alnus incana*(b) O.S. Jørstad (O 68). Lunner: At the cabin N of Roa 24 Apr 1975 *Corylus avellana*(b) J. Stordal 16318 (O 279). Nord-Aurdal: Trondrud 27 Jun 1930 *Alnus*(b) A. Hagen (O 43). Bjørklund Jul 1931 A. Hagen (O 254). Aurdal summer 1931 *Alnus incana*(b) A. Hagen (O 25). Skørravegen 25 Dec 1932 *Alnus incana*(b) A. Hagen (O 39). Skøre at Gullhaug 10 Apr 1933 *Betula*(b) A. Hagen (O 24). Sislebekk 6 Oct 1933 *Alnus*(b) A. Hagen (O 256). Møllerskogen 26 Apr 1935 *Alnus incana*(b) A. Hagen (O 268). Ringebu: Ringebu s.d. N.G. Moe (O 26), s.d. *Alnus*(w) S.C. Sommerfelt (O 36), Dec 1829 *Alnus*(w) S.C. Sommerfelt (O 35). Stuelibron 13 Jun 1868 *Alnus*(b) Zetterstedt (UPS). Ringebu rectory 1 Jan 1980 *Alnus*(b) J. Stordal 20510 (O 238). Sel: Selsverket, Stampen mill 2 Jun 1965 *Alnus*(b) F.-E. Eckblad (O 41). Nord-Sel at the river 15 Aug 1991 *Alnus*(b) A.-E. Torkelsen 129/91 (O 269). Søndre Land: Land Odnesberget 8 Jun 1880 *Corylus*(b) J.M. Norman (O 63). Vassenden at Vestre Bjonevann 15 Oct 1973 *Alnus*(bw) A.-E. Torkelsen 145/73 (O 58). Sør-Aurdal: S. Liagrenden Rustøe-vegen between Moen and Haugasagen s.d. *Alnus incana*(b) A. Hagen (O 267). Vågå: Sande at the N-side of Vågåtunet 8 Jul 1975 *Alnus incana*(b) I. Røsberg (BG 194). Østre Toten: Hensvoll farm S of Kapp 30 Apr 1977 *Alnus incana*(b) J. Stordal 18130,18135 (O 277,284). Øyer: Øyer Jan 1823 *Alnus*(b) S.C. Sommerfelt (O 21). Søre Brynsåa 18 May 1975 *Corylus*(b) T. Kummen (BG 47). - Bu: Drammen: Skoger Stordammen 15 May 1954 *Alnus*(b) F.-E. Eckblad (O 73). Flesberg: Flesberg 16 Sep 1974 *Alnus incana*(b) (BG 176). Flå: At main road near Flå 6 May 1973 *Alnus*(b) J. Stordal (15095) (O 235). Gol: Gol st. 4 Jul 1973 *Alnus incana*(b) L. Ryvarden (O 210). Hole: Vik 19 Apr 1971 *Alnus*(b) s.n.c. (O 54). Lier: Between Lierbyen and Tranby 15 Sept 1974 *Corylus*(b) AG (BG 175). Modum: Modum 1839 *Alnus*(b) s.n.c. (O 27). Gulsrud at Tyrifjorden 15 Sep 1974 *Corylus*(b) A. Bertelsen (BG 178). Tannberg at Tyrifjorden 15 Sep 1974

Corylus(b) E. Fremstad (BG 179). Åmot Skreppe farm 15 Sep 1974 *Alnus glutinosa*(b) I. Røsberg (BG 177). Ringerike: Norderhov s.d. *Corylus*(b) J.M. Norman (O 69). E of Vesetrud 4 May 1952 *Alnus*(b) F.-E. Eckblad (O 62). Rollag: Berg 2 km N of Rollag st. 16 Sep 1974 *Corylus*(b) AG (BG 174). Røyken: Hyggen 16 Oct 1927 *Corylus*(b) I. Jørstad (O 38). Slemmestad 8 Oct 1952 *Corylus*(b) P. Størmer (O 37). Ål: Torpo above the cafe 17 Apr 1973 *Alnus incana*(b) J. Stordal 15035 (O 234). - Ve: Andebu: Moa 10 Aug 1976 *Corylus avellana*(b) O. Vevle (O 239). Borre: Borre May 19 1979 *Corylus avellana*(b) A. Hov (O 281). Karl Johansvern 14 Oct 1981 *Corylus avellana*(b) G. Hungnes (O 272). Lardal: Lardal (Svarstad) Holtan farm 13 May 1967 *Corylus* L. Ryvarden (09) Larvik: Jordfalddalen 7 Sep 1879 *Alnus*(w) A. Blytt (O 46). "Jarlsberg og Laurvigs amts bøkeskover" Sep 1883 *Corylus*(b) A. Blytt (O 80). Kjose Krohnengen 16 Jan 1923 *Corylus*(b) O.A. Høeg (O 83). Viksfjorden at Vikerøy 15 Apr 1968 *Corylus* G. Gulden 10/68 (O 84). At Treschow-Fritzøe-verket 29 Jul 1974 *Corylus*(b) AG (BG 137). Sande: Holm 26 Sep 1922 *Corylus* O.A. Høeg (O 78). Tønsberg: Gullkronen at Jarlsberg Sept 1883 *Corylus* A. Blytt (O 8), 16 Jul 1981 *Corylus avellana*(b) S. Aase (O 276). Slagentangen 30 Mar 1986 *Corylus avellana*(w) P. Marstad 27/86 (O 265). - Te: s.l.d.n.c. *Corylus*(b) (O 71), n.l.n.d. *Alnus incana*(b) Blytt (O 72). Bamble: S of Stokkevann 12 Jun 1974 O. Vevle (BG 200). 2 km W of Langesund 4 Apr 1982 *Corylus*(b) Ø. Weholt 39/82 (TROM 301). Bø: Tveitan Apr 1974 *Corylus* O. Vevle (BG 164). Uvdalsheia N-side of Gygrestolen 27 Jul 1974 *Corylus*(bw) AG 233/74 (BG 169). Drangedal: Drangedal 1 km S of rifle range 25 Jul 1974 *Corylus*(b) AG 202/74, 201/74 (BG 147,148). Kragerø: Kil 24 Jul 1974 *Corylus* AG 199/74 (BG 149). Kviteseid: Kviteseid at the river above the main road 26 Jul 1974 *Alnus*(b), *Corylus*(b) AG (BG 165,166). Nissedal: Årak Jul 1974 *Corylus*(bw) O. Vevle (BG 201,201a). Porsgrunn: Porsgrunn Jul 1840 *Alnus glutinosa*(b) F.C. Schübeler (O 76). Eidanger Vik 4 May 1968 *Corylus*(b) L. Ryvarden (O 30). Sauherad: Gvannes Flåta 12 Mar 1981 *Corylus*(b) B.F. Moen (BG 292). Seljord: Seljord above junior highschool 26 Jul 1974 *Alnus incana*(b) AG 223/74, 220a/74 (BG 167,168). Tokke: Lårdal (Laurdal) 1887 *Corylus*(b) J.M. Norman (BG 67). Dalen 28 Jun 1973 *Alnus incana*(b) L. Ryvarden 11872 (O 275). Vinje: Veggfjella 150m alt. [= Veggsfjell near Vinje] Oct 1941 *Alnus incana*(b) Ch. D. Kohmann (BG 65). - AA: Birkenes: Birkeland 20 Jul 1974 *Corylus*(b) AG 118/74 (BG 153). Bygland: Åraksbø Heddevikji 22 Jul 1974, *Alnus glutinosa*(b) & *Corylus*(b) 2 coll. AG 178/74, 176/74, 169/74 (BG 144,145,146), 26 Jul 1994 *Corylus*(b) AG 63/94 (TROM 297). Froland: 4 km N of Bøylestad bridge 20 May 1977 *Betula*(b) A.-E. Torkelsen 101/77 (O 271). Grimstad: Nørholmen Nørholm 20 Jul 1974 *Corylus*(b) AG (BG 154). Sæveli nature reserve 13 Jul 1995 *Corylus*(b) AG 93/95 (TROM 302). - VA: Farsund: Gaupeland 26 Jul 1995 *Corylus*(b) AG 169b/95 (TROM 309). Flekkefjord: Hidra Rasvåg 17 Jul 1974 *Alnus glutinosa*(bw) AG 92/74 (BG 152). Hoksvatnet S of Randesund 19 Jul 1974 *Alnus glutinosa*(b) AG 107/74 (BG 155). Kristiansand: Kristiansand s.d.n.c. *Corylus* p.p.(b) (O 287). Lindesnes: Vigeland 17 Jul 1974 *Corylus*(b) AG 99/74, 101a/74 (ass. with *H. howeianum* (how 5)) (BG 150,151). Lyngdal: Veggja 18 Apr 1973 *Corylus* G. Gulden (O 10). Mandal: Nomevatnet 18 Jul 1995 *Corylus*(b) AG 148/95 (TROM 306). Vennesla: Kile 23 Jul 1995 *Corylus*(b) AG 180/95 (TROM 307). - Ro: Eigersund: Egersund 14 Jul 1974 *Corylus*(b) AG 79/74, *Alnus*(b) AG 77/74 (BG 160,161), 14 Jul 1974 *Corylus*(b) (vegetative stromata) AG 76/74 (BG 159). Finnøy: Kyrkøy Sjernarøy between Eik and Kattnes 28 Jul 1968 *Alnus glutinosa* P.M. Jørgensen 2232 (BG 190). Gjesdal: Dirdal 13 Jul 1974 *Alnus*(b) AG 67b/74 (BG 162). Hjelmeland: Årdal Melsåsen at Riskadalsvann 31 Jul 1969 *Alnus glutinosa* L. Ryvarden (O 8). Hjelmeland 12 Jul 1974 *Alnus*(b) AG 58/74 (BG 163). Sandnes: Osaland 29 Jun 1969 *Alnus*(b) P.M. Jørgensen (BG 202). Suldal: Sand at Eide NE of people's college 20 Jan 1973 *Alnus*(bw) J. Berge (BG 44). Sand 12 Jul 1974 *Alnus incana*(b) AG 47/74 (BG 158a-b). Hylsfjorden Hylen 25 Jul 1994 *Corylus*(b) AG 53/94 (TROM 296). Tysvær: Tysvær Liarvåg 9 Feb 1976 *Alnus glutinosa*(b) S. Bakkevig (BG 60). - Ho: Askøy: Davanger 29 Apr 1973 *Corylus*(w) (effused form) A. Bertelsen (BG 5). Etne: Etne at the rectory 14 Jun 1863 *Alnus*(b) Chr. Sommerfelt (O 79, ex herb. Chr. Sommerfelt). Granvin: Folkedal 4 Apr 4 1950 *Corylus*(b) J. Stordal 3596 (O 75). Kvanndal at the ferry station 8 Apr 1974 *Corylus*(b) J. Berge (BG 138). Granvinvatnet at the crossroads Ulvik-Voss 5 Sep 1974 *Corylus*(b) J. Berge (BG 205). Hillside 200 m N of Eide railway st. 24 Jul 1994 *Corylus*(b) AG 42/94 (TROM 293). Kvam: Strandebarm Tvedt 29 Mar 1913 *Alnus*(b) T. Lillefosse (O 74). Kvinnherad: Matrefjord between Holmedal and Indre Matre S of Tverberg 20 Jul 1975 *Corylus*(b) J. Berge (BG 191). Lio 1 km W of Sandvik (= 2 km E of Ljosnes) 5 Sep 1975 *Alnus*(b) J. Berge (BG 143). Odda: Odda 10 Jul 1974 *Alnus*(b) AG 33/74 (BG 156), *Corylus*(bw) AG 36/74 (BG 157). Sandvin and Hildal 24 Jul 1994 *Corylus*(b) AG 47/94, 48/94 (TROM 294,295). Os: Søfteland s.d. O. Hagem (O 280). Hattvik 1 Sep 1972 *Corylus*(b) F.-E. Eckblad (BG 192), 27 Apr 1973 *Corylus*(b) D.O. Øvstedal (BG 6), 20 May 1973 *Corylus* AG (BG 4). Halgjem 8 Apr 1973 *Corylus*(b) F.-E. Eckblad (BG 193). Ulvik: Osa 8 Oct 1931 *Corylus*(b) I. Jørstad (O 77), 3 Aug 1951 *Alnus incana* J. Stordal (BG 207). Ulvik 200m NW of Ulvik Camping at the river 9 Jul 1974 *Alnus incana*(b) AG 19/74 (BG 141), *Corylus*(b) AG 24/74 (BG 142). Voss: Mølsteråsen Hanguren 6 May 1948 *Corylus avellana*(b) J. Stordal 1105 (O 259). Hellesnes 13 Apr 1950 *Corylus avellana*(w) J. Stordal 3629 (O 289), 11 Jun 1973 *Corylus*(b) J. Berge (BG 23). Voss hillside above railway st. 8 Jun 1974 *Alnus*(b) AG 4/74

(BG 139), *Corylus*(b) AG 5/74 (BG 140). Bulken W of railway 1 May 1975 *Corylus*(b) J. Berge (BG 48), below Ransmulen May 10 1980 *Corylus avellana*(b) A. Lundberg (OULU 310). 250 m W of railway st. 1 May 1975 *Corylus*(b) J. Berge (BG 50). - SF: Askvoll: Stongfjorden 10 Jul 1974 *Corylus avellana* O. Balle (BG 311). Balestrand: Dragsvik 10 Sep 1975 *Corylus*(b) AG (BG 206). Flora: Eikefjord 10 Jul 1973 *Alnus*(b) AG 3/73 (BG 180). Gloppen: Lote 10 Jul 1973 *Corylus*(b) AG 16/73 (BG 181). Lote-Åsane 16 Jul 1975 *Corylus*(b) E. Fremstad (BG 212). Jølster: At Ripe in Kjøsnesfjord 14 Jan 1973 *Corylus*(b) O. Befring 327 (BG 1). Leikanger: Leikanger above Frækalandgarden 28 Jul 1975 *Corylus*(b) O. Aas (BG 49). Leikanger 9 Sep 1976 *Alnus incana*(b) O. Aas (BG 213). Sogndal: Slinde 29 Jun 1948 *Corylus avellana*(b) J. Stordal 1301 (O 263). 500m above Sogndal church 25 May 1973 *Corylus avellana*(b) J. Stordal 15150 (O 258). Stedje 22 Jul 1994 *Corylus*(w) AG 36/94 (TROM 298). Vik: W-slope of Krokegga 30 Jul 1995 *Corylus*(b) AG 207/95 (TROM 308). - MR: Molde: The road towards Varden 25 Sep 1953 (imm. stromata) *Corylus*(b) J. Stordal 9214 (O 64). Nesset: Øverås 14 Jul 1973 *Corylus*(bw) AG 64/73 (BG 183), *Alnus incana*(b) AG 66b/73 (BG 184). Eikesdalen Litlevatnet 17 Aug 1991 *Corylus*(b) A. Bujakiewicz, S. Sivertsen, A.-E. Torkelsen K-91-29 (TRH 300). Eikesdalen Reitan 17 Aug 1991 *Alnus*(b) (O 282). Rauma: Åndalsnes 13 Jul 1973 *Corylus*(bw) AG 63/73 (BG 182). Stryn: Strynsvatn Flostranda nature reserve 20 Jul 1994 *Corylus*(b) AG 5/94 (TROM 299). Tingvoll: Gyl 3 Jul 1975 *Corylus*(b) I. Røsberg (BG 195). Vulvik-Gyl 3 Aug 1975 *Corylus*(b) O. Balle (BG 196). Ulstein: Eiksund 1km E of ferry station 17 Jul 1975 *Corylus*(b) I. Røsberg (BG 51). - ST: Hemne: S-side of Kleivhaugen NE of Myrhaugen 27 May 1969 *Corylus*(b) E. Aune (O 61). Aspeli 4 Jul 1975 *Corylus*(bw) O. Balle (BG 198). N of Vinjefjorden 17 May 1979 *Corylus avellana*(b) E.I. Aune (TRH 290). Klæbu: Hyttforsberg 1 Apr 1975 *Corylus* T. Klokk (TRH 208). Meldal: At Storås Apr 1973 *Alnus incana*(b) E. Fremstad (BG 3). Melhus: Hovin near Gaula bridge 1 Oct 1933 *Alnus incana*(b) O.A. Høeg (TRH 135). Rennebu: Flå between Berkåk-Stamnan 31 Jul 1974 *Corylus*(b) E. Fremstad (BG 204). Rissa: Stadsbygd Reitan 13 May 1937 *Corylus*(b) O.A. Høeg (TRH 136). Rissa 18 Jul 1973 *Corylus*(b) AG 101/73 (BG 185). Trondheim: Kuhaugen in Trondheim 1 Apr 1934 *Corylus*(b) O.A. Høeg (TRH 134). Byneset (Sundene) 5 Jul 1975 *Corylus*(b) O. Balle (BG 197). - NT: Levanger: Hammervatnet 20km S of center of Levanger Feb 1973 *Alnus incana*(b) Bj. Lundeberg (BG 2). Namsos: Hals farm 18 Apr 1971 *Corylus avellana*(b) J. Stordal 13755 (O 237). Snåsa: Snåsa Bergsåsen 20 Jul 1973 *Corylus*(b) AG 123/73 (BG 188). Steinkjer: Hjelle 12 Apr 1967 *Corylus avellana*(b) J. Stordal 12155 (O 257). Stjørdal: Gjerningåsen 7 May 1972 *Alnus incana*(b) J. Stordal 14535 (O 260). Fosslia 2 Oct 1974 *Corylus*(bw) E. Fremstad (BG 211). Follvik at Nylende farm 6 Jul 1975 *Corylus*(b) O. Balle (BG 199). Verran: Malm 19 Jul 1973 *Corylus*(b) (partly effused stroma), *Alnus incana*(b) AG 109/73, 108/73 (BG 186,187). - No: Saltdal: Salten s.d. *Alnus*(w) S.C. Sommerfelt *Sphaeria fusca* P. var. (E. Fries scrips.) (UPS, herb. E. Fries). Saltdalen May 1821 *Alnus incana*(b) S.C. Sommerfelt (O 82) (Sommerfelt 1827: 44 as *Sphaeria fusca*). - Tr: Bardu: Setermoen Moegga 10 Jun 1999 *Alnus incana*(bw) AG 32/99, 38/99 & G. Mathiassen (TROM). - Fi: Tana: Tana river near bajit Viõis 21 Aug 1989 *Alnus kolaensis* Orlova (b) (= *A. incana* var. *virescens* Wahlenb.) A. Bujakiewicz & S. Sivertsen SS89-91 (TRH 291). - *Reference*. Ho: Ullensvang: Vik (Eidfjord) Aug 1887 "on dead branch of *Corylus Avellana*" James W.H. Trail (Trail 1889: 491). **Austria:** Carinthia: 5 km SSW of Gmünd at highroad E14 alt. 600 m 2 May 1972 *Alnus incana*(b) N. Lundqvist 7461 (UPS). **Germany:** Umgebung v. Münster b. Wolbeck 1863 leg. Nitschke *H. purpureum* (Nitschke 1867:37) (B, ex herb Nitschke, LECTOTYPUS, selected here). **Italy:** L. Rabenhorst Fungi europaei 628. *Hypoxylon fuscum* (Pers.) Fr. In nemoribus prope Pisam in ram. emort. *Alni glutinosae*(b), 1862 leg. Beccari (K). **Sweden:** Småland: Femsjö Dullaberget 13 Aug 1929 *Corylus*(b) J.A. Nannfeldt 3109 (BG 219). - Öland: St. Dalby Aug 1969 *Corylus*(b) O. Vevle (BG 56). - Gotland: Hejde Aug 1895 *Corylus*(b) T. Vestergren (UPS). Ekeby Sep 1895 *Corylus*(b) T. Vestergren (UPS). - Västergötland: Göteborg Stora Änggården Naturparken 9 Jan 1937 *Alnus*(w) T. Nathorst-Windahl 353 (UPS). - Uppland: Ärentuna parish Storvreta Forest ca 4 km SE of the village 24 Apr 1967 *Corylus*(w) N. Lundqvist 5260 (BG 227). - Gästrikland: Valbo parish at the mouth of the rivulet Stenbäcken into the river Gävleån 21 Apr 1973 *Corylus*(b) J.A. Nannfeldt 22947 (UPS). - Hälsingland: Ängersjö parish Kvarnberget 20 Oct 1901 *Alnus*(b) M. Östman (UPS). **Country unknown:** S.l.d.n.c. as *Sphaeria atropurpurea* Tode? *Sphaeria fusca* Pers. (L 910.370-305, herb. Persoon).

Hypoxylon howeianum Peck

A. Rep. N. Y. St. Mus. 24: 98 (1872). - Anamorph: *Nodulisporium* (L.E. Petrini & Müller 1986).

Figs 11 A-D, 17 (stroma), 20 (map), 37.

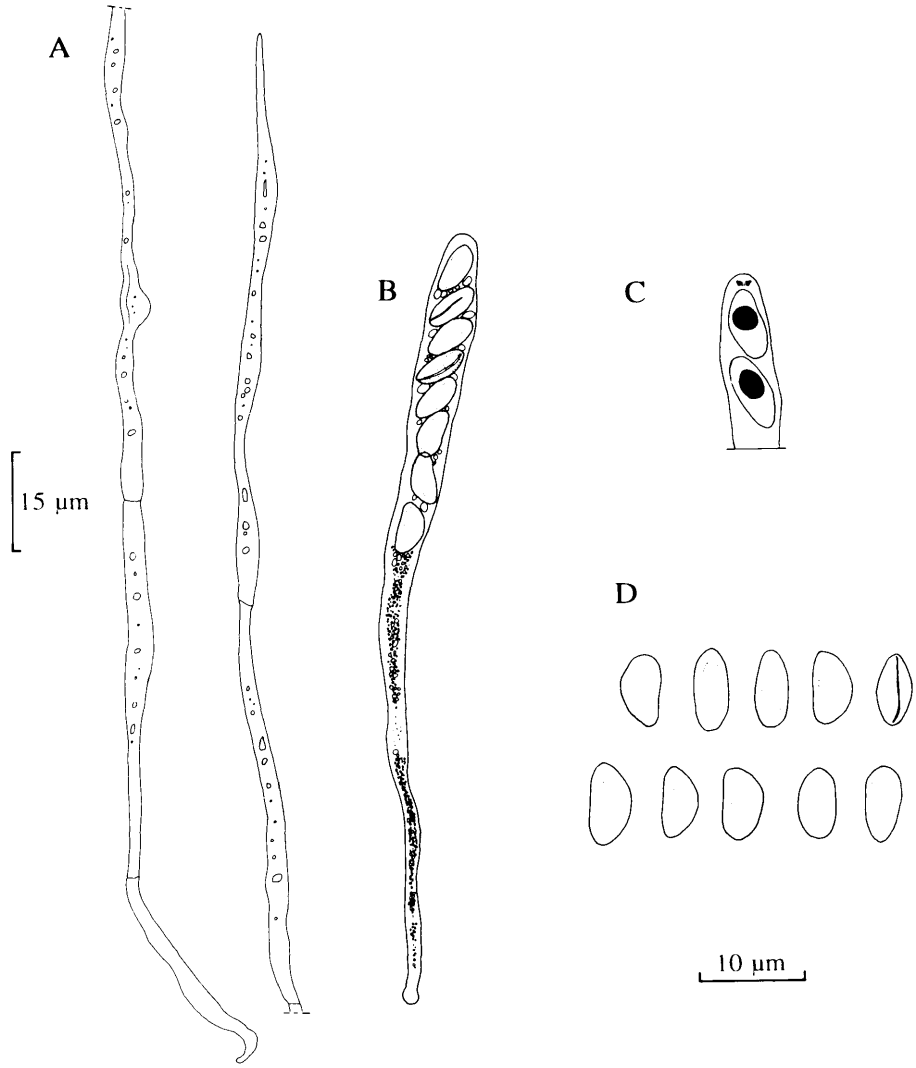
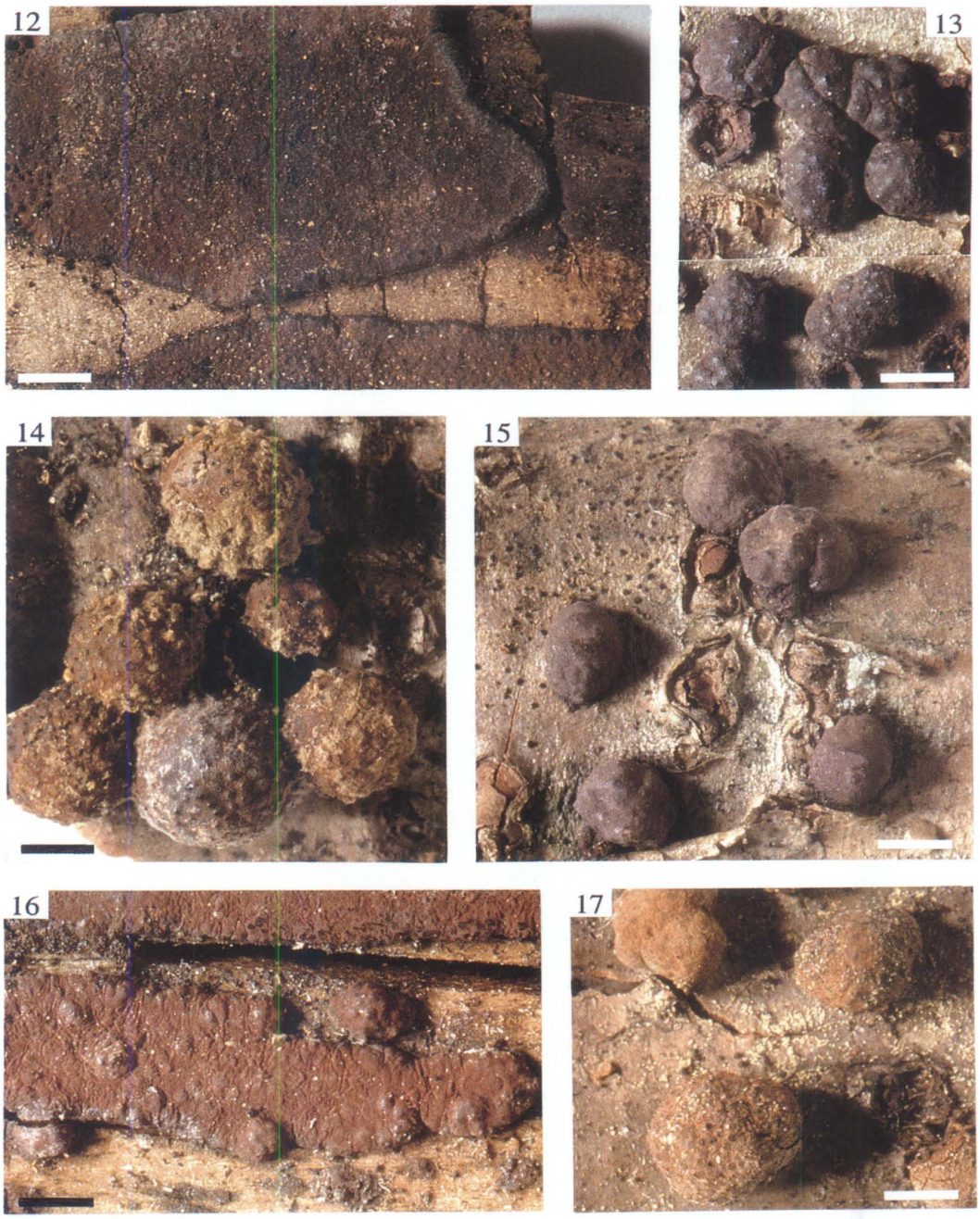


Fig. 11. *Hypoxylon howeianum*. A. Paraphysis. B. Ascus. C. Ascus apex in MZ. D. Ascospores. From BG 9.

Description. *Stromata* 0.3-0.8 cm in diameter, ca. 0.5 cm high, globose to subglobose, in groups on bark. Young stromata may occur close to or on top of older ones and thus form large aggregates. Young stromata grey brown to brownish red, depending on whether they are covered by a grey mycelial web, or, more frequently, by a yellowish brown or brownish red pruina, ca. 50 μm thick. Anamorph synnemata often connect the stromata to the surrounding bark. Mature stro-



Figs 12-17. Photographs of stromata. Fig. 12. *Hypoxylon cercidicola* (BG 1). Fig. 13. *H. cohaerens* (BG 7). Fig. 14. *H. fragiforme* (BG 24). Fig. 15. *H. fuscum*, pulvinate specimen (TROM 294). Fig. 16. *H. fuscum*, effused-pulvinate specimen (O 265). Fig. 17. *H. howeianum* (TROM 6). - Rule: 2 mm.

mata smooth or finely roughened from perithecial protrusions, violet brown, finally dark brown or black. Outermost stroma often peeling. *Ectostroma* of young stromata ca. 100 μm exclusive of pruina, waxy, shiny, with inside yellowish orange or orange. *Entostroma* basal part to 4 mm, dark brown, soft woody, often faintly zoned. *Perithecia* 320-450 μm high, 230-410 μm broad, wall 17-25 μm, almost globose, uni- to biseriate. Ostioles umbilicate, canal 80-100 μm long. *Asci* p.sp. 48-74 × 5-7 μm, m. 58 × 6.3 μm, st. 56-80(-97) μm, m.70 μm, with amyloid discoid annulus ca. 1.5 × 0.5 μm. *Paraphyses* to 300 μm long and 3 μm broad, septate, no branching observed, with yellow guttules. *Ascospores* 6.5-10.5(-11) × 3-4.5(-5.5) μm, m. 8.4 × 3.9 μm (n=128/6), inequilaterally ellipsoid, brown, with dehiscent perispore and 1-2 guttules. Germ slit the entire length of the spore on the convex side.

Taxonomic notes. Peck (1872) was aware of the small spores of *Hypoxylon howeianum* as compared with *H. fragiforme*, but did not give any measurements. This may be one reason why it was confused with *H. fragiforme* for such a long time. Shear (1928), who had intimate knowledge of *Hypoxylon*, synonymized these species. However, because both the teleomorph (in paraphyses, perithecia and ascospores) and the anamorph differ from *H. fragiforme*, and of differences in ecology, its status as a species seems to be well founded.

Ecology. *Hypoxylon howeianum* occurs on corticated trunks and branches of primarily *Corylus avellana*, more rarely on *Alnus incana* and *Quercus* spp. It is rarely seen on decorticated wood. In Norden it is also recorded on *Alnus glutinosa*, *Carpinus betulus*, *Populus*, *Prunus*, *Sorbus*, and once on *Fagus* (Granmo et al. 1989). It evidently also has some capacity to attack relatively fresh wood. Norwegian collections rarely have mature ascomata.

Distribution. *Norway*. Ak, Ve, Te, AA, VA, Ro, Ho. The distribution is largely limited to the southern coastal area, in spite of available hosts inland and further north. This coincides well with the Nordic distribution (Granmo et al. 1989). The northernmost locality is Eide in Granvin (Ho) (60° 30'N, 6° 44'E). *Total*. Temperate and Subtropical regions. Denmark, Sweden, Finland; all Europe, Russia; China (Teng 1996); India, South Africa, North and South America, Australia, New Zealand (Miller 1961, Ju&Rogers 1996).

Differentiation. See *H. fragiforme*.

Comments. The first records of *Hypoxylon howeianum* from Norway are those of Granmo (1977) and Granmo et al. (1989, as *H. howeanum*).

Specimens examined. Norway: S.l.d.n.c. (vegetative stromata) *Corylus*(b), as *H. coccineum* Bull. det. E. Rostrup (O 2). - Ak: Bærum: Eikeli 20 Nov 1966 (ass. with *H. fuscum*) *Corylus*(b) T. Schumacher (BG 12). - Ve: Borre: At Knutsrød farm 7 May 1967 (vegetative stromata) *Corylus*(b) K. Fredriksen (O 4). Sandefjord: Svines at Goksjø 3 May 1965 *Corylus*(b) F.-E. Eckblad (BG 8, O 13). - Te: Bamble: Sandvika 13 Apr 1981 *Corylus* Ø. Weholt (O 19). - AA: Risør: Flostaøya Langmyr 2 Jun 1978 *Quercus*(b) A.-E. Torkelsen (O 18). - VA: Lindesnes: Vigeland 17 Jul 1974 *Corylus*(b) AG 97/74 (duplicate), 101b/74 (ass. with *H. fuscum*) (BG 6,5). Søgne: Lonelia 17 Sep 1959 *Corylus avellana*(b) J. Stordal (O 21). - Ro: Eigersund: Egersund in the park 14 Aug 1963 (vegetative stromata) *Alnus*(w) F.-E. Eckblad (O 3). Hjelmeland: Hjelmeland 12 Jul 1974 *Corylus*(b) AG 57/74 (BG 7). - Ho: Granvin: 200 m W of Eide railway st. 2 May 1948 *Alnus incana*(b) (ass. with *H. multiforme*) J. Stordal (O 20). The hillside NW of Eide railway st. 11 Sep 1951 *Corylus*(b) J. Stordal 6740 (BG 11). Lussand W of Kvanndal 3 Aug 1972 *Corylus*(b) F.-E. Eckblad (BG 9). Kvam: Norheimsund Norheim-Sloberg 22 Sep 1950 *Corylus*(b) J. Stordal 5507 (BG 10). Hatlestrand at Grønevik 4 Nov 1973 *Corylus*(b) F.-E. Eckblad (BG 1, UPS). - *Reference*. Oslo: Bygdøy Oscarshall Aug 1903 an Haselnussästen P. Hennings (Hennings 1904: 28 as *Hypoxylon coccineum*). **Croatia:** Krakovski gozd ca. 50 km W of Zagreb 15 Oct 1976 *Quercus robur* M. Tortić (BG 14). **Sweden:** Öland: Persnäs parish Stenninge S-wards 28 Jul 1953 *Alnus glutinosa*(b) J.A. Nannfeldt 13226 (UPS). Legenäs S-wards 1 Aug 1953 *Corylus*(b) J.A. Nannfeldt 13306 (UPS). - Uppland: Alsike parish Rickebasta träsk 28 Oct 1938 *Alnus glutinosa*(b) S. Lundell & H. Smith (UPS).

Hypoxylon laschii Nitschke

Pyren. Germ.: 36 (1867). - *H. laschii* Nitschke ssp. *onnii* P. Karst., Medd. Soc. Fauna Fl. fenn. 14: 147 (1887). - Anamorph: Unknown.

Figs 18 A-C, 27 (stroma), 40.

Description. *Stromata* (0.15-)0.3-0.6 cm in diam., 0.15-0.4 cm high, pulvinate to hemispherical, emerging from bark, at times encircled by ruptured bark. The grey brown to brown surface, rough by the perithecial elevations, is spotty obscured by a greyish to reddish brown pruina. Old stromata dark brown. *Ectostroma* without pruina 30-40 μm, waxy, shiny, inside orange. *Entostroma* with orange granules in the uppermost part, basal part 0.5-1.5 mm; brown with grey spots, soft; tissue consisting of thick-walled almost circular cells, 5-15 μm in diam. *Perithecia* 440-770 μm high, 360-680 μm broad, subglobose, uniseriate, occasionally biseriate, wall ca. 40 μm. Ostioles broadly conical, frequently with a small flat area around the pore, umbilicate, rarely papillate. *Asci* p.sp. 60-80 × 7-8.5 μm, m. 69 × 7.4 μm, st. 35-85 μm, m. 45 μm, amyloid with reduced, discoid annulus, 2.5-3.5 × 0.5 μm. *Paraphyses* probably dissolved. *Asco-*

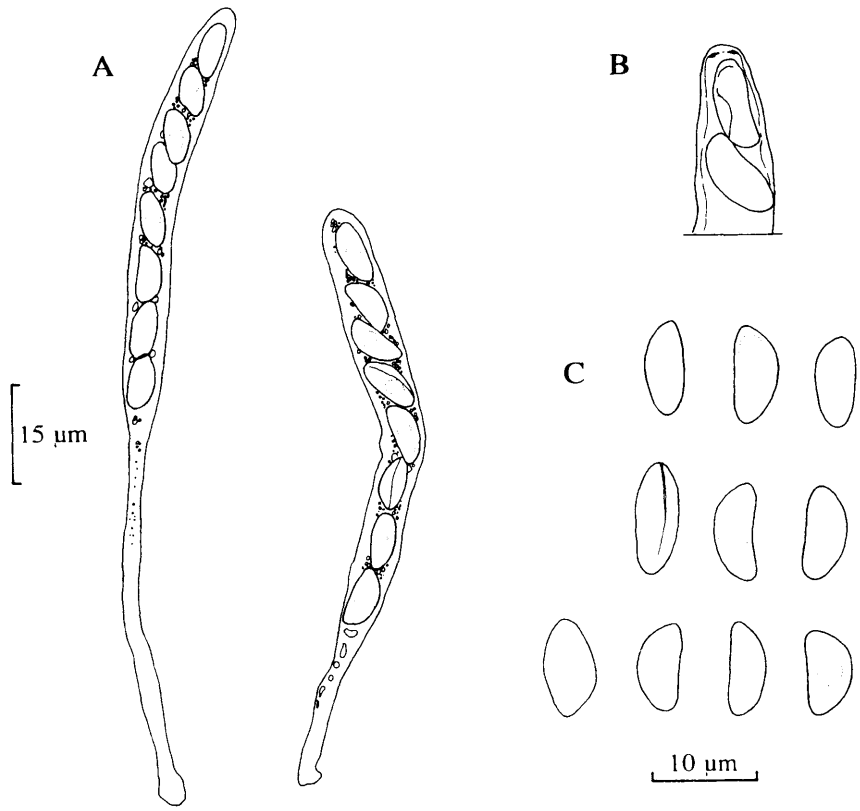


Fig. 18. *Hypoxylon laschii*. A. Asci. B. Ascus apex. C. Ascospores. From O 1, except for the right ascus which is from UPS, E. Haglund.

spores 8.5-11 × (3-)3.5-5 μm, m. 9.7 × 4.1 μm (n=81/4), inequilaterally ellipsoid to lunate, brown (8D8) to dark brown, with 0-1 guttule and dehiscent perispore, epispore smooth (SEM). Germ slit spore-length on convex side, often with a distinct bend at one end.

Taxonomic notes. L.E. Petrini & Müller (1986) included *Hypoxylon laschii* in *H. rubiginosum* var. *perforatum* (Schwein.) L.E. Petrini (= *H. perforatum* (Schwein.: Fr.) Fr.). Miller (1961) synonymized *H. laschii* with *H. rubiginosum*. He also studied the same specimens of *H. onnii* P. Karst. (ined.) in UPS (leg. Haglund, leg. Starbäck) I have studied, but erroneously cited them (Miller 1961: 65) under *Hypoxylon mammatum* (= *Entoleuca m.* (Wahlenb.) J.D. Rogers & Y.-M. Ju), with which they have nothing in common. *Hypoxylon perforatum* is not known for certain from Norway or Norden. In Europe it has been collected on *Fraxinus* and *Fagus* (L.E. Petrini & Müller 1986).

Ecology. In Norway and Norden the species is recorded on corticated, dry branches of ornamental *Populus* species like *P. alba* and *P. nigra*.

Distribution. *Norway.* Oslo. *Total.* Sweden, Finland (Mustiala); Poland (Nitschke 1867). Ju & Rogers (1996) also reported it from Maine, U.S. on corticated *Populus tremuloides*. Owing to scanty records, and intermingling with *H. rubiginosum* or *H. perforatum*, nothing for sure can be said about its distribution in general.

Differentiation. The pulvinate stromata of *Hypoxylon laschii* differs from *H. fuscum* by its rough stromata spotted with reddish pruina. The erumpent growth habit and thicker basal entostroma are different from the related *H. rubiginosum*.

Comments. *Hypoxylon laschii* was previously recorded from Norway by Granmo (1977), and for Norden by Granmo et al. (1989, as *H. rubiginosum* var. *perforatum*). Until now only two old Norwegian specimens are known, and a specimen I collected in eastern Norway on *Populus* in 1974 has unfortunately been lost. It is obviously a very rare taxon.

Specimens examined. Norway: Oslo: Tøyen s.d. *Populus alba*(b) *Sphaeria fusca* N.G. Moe, Oct 1840 in rami putridio *Populus alba*(b) *Sphaeria fusca* N.G. Moe (O 1,2). **Poland:** In der Neumark bei Driesen s.d. (capsule lacking collector's name, but probably collected by von Lasch acc. to Nitschke, 1867) *Populus*(b) *H. laschii* n.sp. Nitschke (Nitschke 1867:36) (B, LECTOTYPUS (Gerhardt & Hein 1979); HOLOTYPUS sec. Ju & Rogers 1996). **Sweden:** Upl: Uppsala 18 Sep 1884 *Populus nigra*(b) *H. onnii* Karst. E. Haglund (UPS), 27 Apr 1888 *Populus nigra*(b) *H. onnii* Karst. K. Starbäck (UPS).

Hypoxylon macrosporum P. Karst.

Enumeratio fungorum et Myxomycetum in Lapponia orientalis aestate 1861 lectorum: 211 (1866, preprint, n.v.), Not. Sällsk. Fauna Fl. fenn. Förh. 8: 211 (1882). - *Hypoxylon vogesiacum* (Pers.) Sacc. var. *macrosporum* J.H. Mill., Mycologia 25: 325 (1933). - Anamorph: *Sporothrix*-like, less frequently *Nodulisporium*-like (Ju & Rogers 1996).

Figs 19 A-C, 21 (map), 28 (stroma), 55-56 (SEM).

Description. *Stromata* 0.6-12 × 0.2-0.6 × 0.08-0.12 cm, in patches or elongate bands on wood close to the edges of bark, very rarely on bark and then pulvinate or hemispherical, 0.4-1 cm in diameter, 0.2-0.4 cm thick; usually with discrete margins, rarely attenuated at some edges to a thin, brown covering. Stroma surface at times covered with a thin, white or usually brown pruina, rough from perithecial contours and slightly scabrid. Young and mature stromata reddish brown (9E5) to violet brown (11F7, 11F6), older stromata become dark ruby red (12F3) to dark brown (7F5). *Ectostroma* with a faintly carbonized crust only 20-30 μm thick, covering an orange

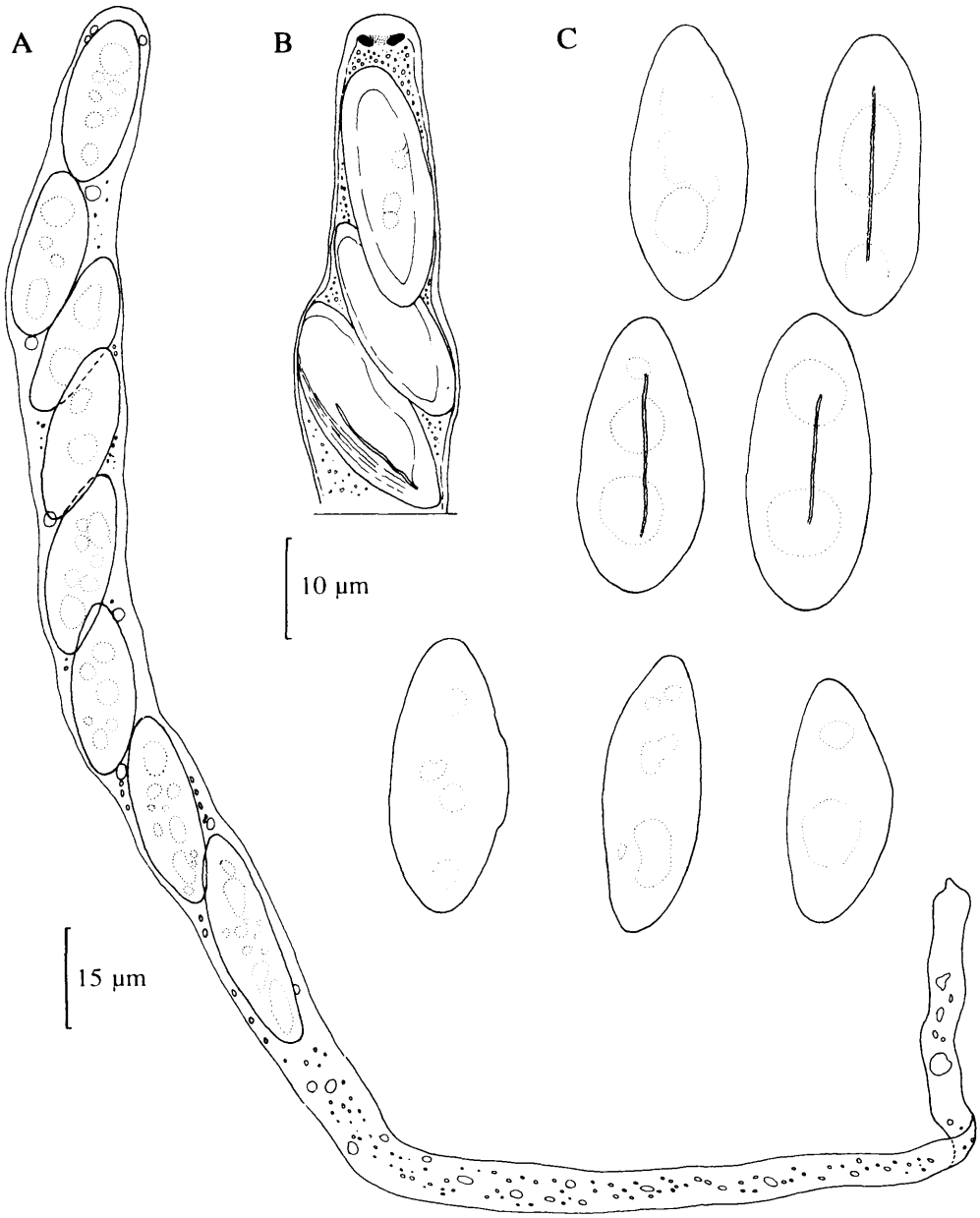
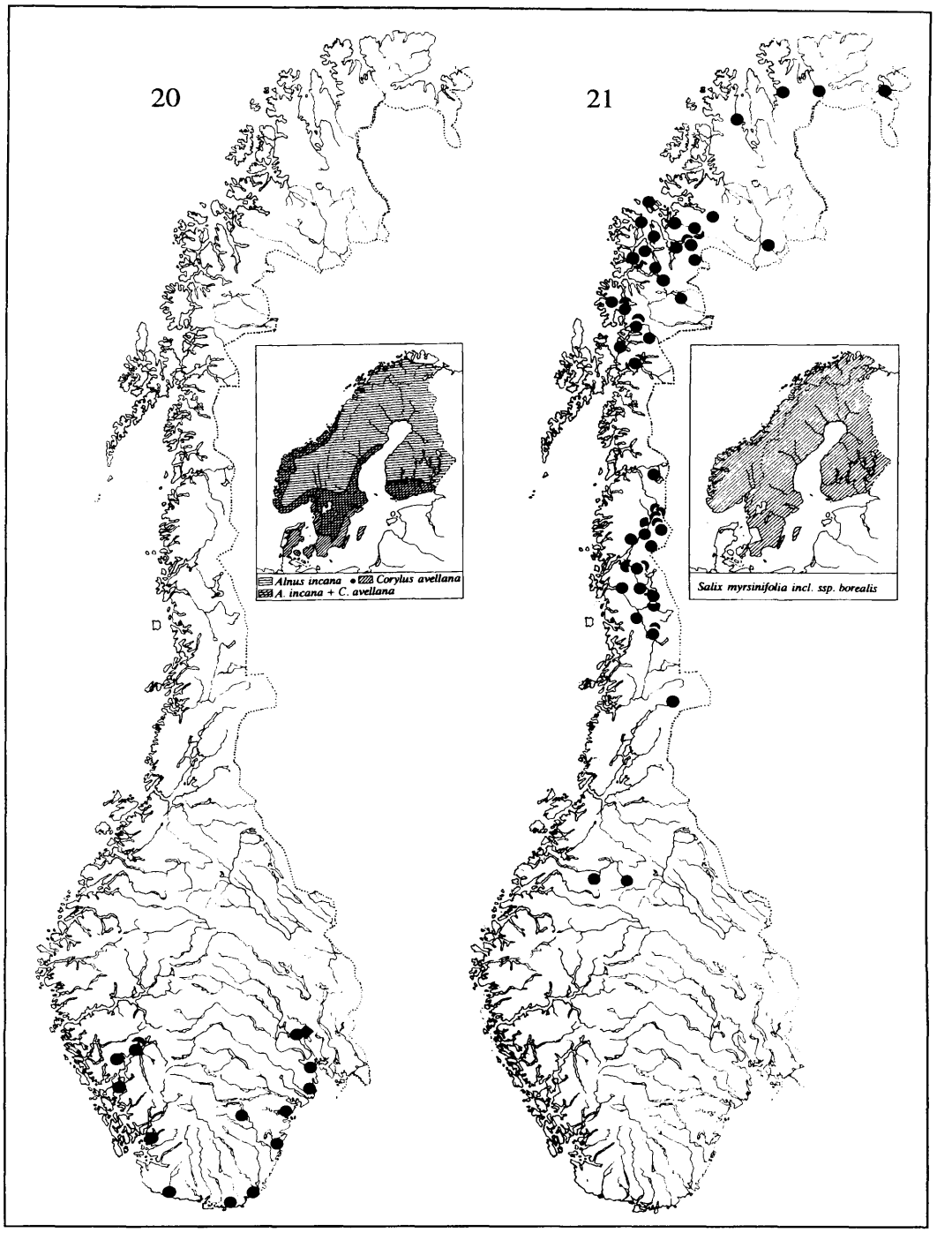


Fig. 19. *Hypoxylon macrosporum*. A. Ascus. B. Ascus apex in MZ. C. Ascospores. From BG 2.

or blood red stratum which merges further down into a brown, soft *entostroma* with basal part 100-300 µm. *Perithecia* 450-650 µm high, 250-480 µm broad, or 300-450 µm diam., ovoid to



Figs 20-21. Distribution in Norway. Fig. 20. *Hypoxylon howeianum* and the Nordic distribution of its most common hosts. Fig. 21. *Hypoxylon macrosporum* and the Nordic distribution of one of its most common hosts. The two clusters reflect the collecting of G. Mathiassen.

pyriform, usually uniseriate, in pulvinate stromata 2-3-seriate. Perithecial elevations strong, ovoid, protruding to l/3-2/3 of perithecial height. Ostioles umbilicate, or frequently bluntly papillate. *Asci* p.sp. 140-180 × 12.5-17 μm, m. 145 × 14.5 μm , st. 70-130 μm, m. 95 μm, faintly amyloid with discoid annulus 4-5.5 × 1.5-2 μm. *Paraphyses* exceeding the asci, 3.5-4.5 μm broad, septate, sparsely branched. *Ascospores* (19.5-) 22-34 × 7-13.5 μm, m. 25.5 × 9.4 μm (n= 220/10), oblong ellipsoid to inequilaterally ellipsoid, at times slightly ovoid, brown (7C7); with several guttules and 0.7 μm thick, smooth perispore and finely granulose epispore (SEM). Germ slit 1/3-2/3 of spore-length (7-18 μm long), on the most convex side in inequilateral spores.

Taxonomic notes. Several authors have followed Miller (1933, 1961) in treating *Hypoxylon macrosporum* as a variety of *H. vogesiacum*. I find no reasons for considering it a near relative to that species. As demonstrated by Martin (1969: 168), and confirmed by later authors, Miller (1961) erroneously synonymized it with the totally different *Hypoxylon (= Entoleuca) mammatum* (Wahlenb.) P. Karst.

Ecology. *Hypoxylon macrosporum* is found on decorticated areas of dry branches of several species of *Salix*, of which *S. myrsinifolia* s.l. is the commonest host in North Norway (Mathiassen 1989: 54). It has been recorded once on *Alnus viridis* in Europe (L.E. Petrini & Müller 1986), but there too *Salix* is the primary host. Its habit of developing stromata close to the bark, although very seldom on the bark itself, is a characteristic feature. Dark stromatic zones extend down into the dry, fresh wood. I consider the species to be a primary, aggressive saprobe.

Distribution. *Norway*. MR, ST, NT, No, Tr, Fi. *Hypoxylon macrosporum* is a northern species common in North Norway. The southernmost known site is Sunndal (MR) at 62° 28 'N, 8° 55 'E. In North Norway, Mathiassen (1993) found it to be most frequent in the northern boreal and low alpine regions, while it was absent from the coastal area in southern Nordland. *Total*. Sweden; Russia (Kola peninsula) (Karsten 1882: 211), southeastern Russia (Chabarowsk and Kuril Islands) (Cherepanov 1993), in the Alps (L.E. Petrini & Müller 1986), Greenland (Whalley & Knudsen 1985), western United States (Miller 1961), western Canada (Ju & Rogers 1996). The species has its main distribution in the boreal regions.

Differentiation. *Hypoxylon macrosporum* is easily recognized. By ocular judgement it may be confused only with *H. rubiginosum* and *H. salicicola* from which it differs in its darker brown - not rusty - colour and in its discrete stromatal margins and pronounced perithecial projections. When in doubt the spore size will be conclusive.

Comments. Bearing in mind the extensive botanical investigations carried out in the Scandinavian mountains, it is remarkable that none had ever collected or recognized this large pyrenomycete here until 1973 (Granmo 1977). During the Nordic Mycological Congress in Østersund, 1982, I could demonstrate its presence also in Sweden. The species was later dealt with in Norway by Mathiassen (1985, 1989, 1993) and in the Nordic countries by Granmo et al. (1989). It is the least pigmented of the Norwegian species in sect. *Hypoxylon*.

Specimens examined. Norway: (all the GM-collections are on various species of *Salix*, all deposited in TROM (cf. Mathiassen 1989, 1993)). MR: Sunndal: Grøvudalen Gammelsetra 850 m alt. 1 Sep 1992 *Salix*(w) J.B. Jordal, S. Sivertsen MR92-28 (Jordal 1993: 30) (TRH 14). - ST: Oppdal: Fisktjørnin 1270 m alt. 23 Jun 1984 *Salix lanata*(w) S. Sivertsen 84-16 (TRH 11, ZT). - NT: Snåsa: Gressåmoen National Park 7 Aug 1973 *Salix*(w) L. Ryvarden 12096 (O 1). - No: Evenes: Forra Hoggvik 7 Jun 1981 *Salix*(w) AG 69/81, GM & S. Dunfjeld & (TROM 15). Forra Brenna Skogløsletta 8 Jun 1981 *Salix*(w) AG 93/81 & GM (TROM 16). Lenvika at outlet of Østervikelva 2 Apr 1994 *Salix pentandra*(w) AG 232/95 (TROM 19). Grane: Majavatn *Salix* GM 3282. Øvre Fiplingvatnet GM 3335, 3339. Trofors GM 7781. Hattfjelldal: Hattfjelldal GM 4968, 4975, 4984. Røosvatnet Bjørkåsen GM 5041, 5044, 4999, 5005. Hemnes: Bryggfjelldalen GM 5220, 5244, 5278, 5257a. Korgfjellet GM 5299, 5307, 5308, 5310, 5280, 5283. Tustervatnet GM 5318, 5321, 5325. Rana: Saltfjellet Stødi GM 4466. Saltfjellet Arctic Circle GM 8291, 8301, 8310. Nedre Jamtlia GM 5806, 5808, 5817, 5819, 5828, 5831, 5834. Randalen Stokkalia GM 7511,

7517, 7519, 7526b, 7528, 7530, 7531, 7534. Virvassdalen Verdal GM 7565. Dunderlandsdalen Grotjørnenget GM 7597, 7601. Plurdalen GM 7697, 7702, 7706, 7709a, 7753, 7753d, 7755, 7760. Saltdal: Saltfjellet near Sukkertoppen GM 7500, 7492, 7493, 7494, 7498. Vefsn: Fustvatnet GM 5125, 5129, 5131a. - Tr: Balsfjord: 5 km S of Vollan at main road 1 Aug 1973 *Salix*(w) Ingfrid Granmo & AG 200/73 (BG 7). Laksvatn GM 735. Berg: Elvevoll GM 515, 516, 490, 513. Ibestad: Between Agnneset and Hamran GM 310b, 311. Karlsøy: Karlsøy GM 984, 988, 989, 1010, 1011, 999, 1001. Kvænangen: Kvænangsbotn GM 2454. Kåfjord: Manndalen Dalen GM 749, 756, 761; 772 (pulvinate stromata on bark of *Salix borealis*). Kåfjorddalen E of Sabetjåkka GM 1981, 1973, 2494, 2480, 2484a, 2489, 2476. Lavangen: Bukkemyra GM 2523, 2546, 2524a, 2534, 2536a, 2544, 2528. Lenvik: Laukhella GM 449, 452, 453, 455, 458. Lyngen: Sørlenangen GM 950, 957, 959, 961. Målselv: Dividalen Dødesvann GM 2517, 2502, 2503, 2231, 2233, 2242, 2250, 2257. Nordreisa: Sørkjosen 3 Aug 1973 *Salix*(w) Ingfrid Granmo & AG 221/73 (BG 8. TROM). Reisadalen Josvatn-Josdalen GM 1923, 1924, 1927, 1907, 1953, 1954, 1947. Salangen: Skårvik GM 338. Skårvikdalen GM 372. Skjervøy: Arnøy Årviksand GM 879, 880, 881, 882, 891, 892, 893, 894, 897, 877a. Storfjord: Helligskogen 17 Aug 1992 *Salix glauca*(w) GM (Mathiassen & Granmo 1996: 44) (TROM 12, O, S). Tranøy: Vangsvik GM 424, 429. Tromsø: Tromsøya s.d. *Salix*(w) J.M.Norman (O 9). Tromsdalen GM 1161. Tromsdalen Storsteinen GM 2061a, 2012, 2016, 2027a, 2049, 2057, 2002. Russevankskardet GM 1469, 1470, 1468. Kaldsletta/Solligården 2 Apr 1995 *Salix*(w) AG 2/95, 3/95 (TROM 17,18). - Fi: Kautokeino: Outlet of Anarjokka from Bosminjavri 5 Jul 1969 *Salix phylicifolia*(w) S. Sivertsen (TRH 20). Lebesby: Ifjord at Ifjordelva 1km N of the crossroad 7 Aug 1973 *Salix*(w) AG 259/73 (BG 4, TROM). Porsanger: Russenes 5 Aug 1973 *Salix*(w) AG 250/73 (BG 6. TROM). Sør-Varanger: Kirkenes Bjørnevatn 10 Aug 1973 *Salix*(bw) AG 283/73, 285/73 (BG 2,3). Tana: Tana bridge riverside of Seidajokka 8 Aug 1973 *Salix*(w) AG 275/73 (BG 5). **Russia:** Murmansk region: "Olenji vid Ishafvet on Salix 4. Juli 1861" P.A. Karsten leg. & det. (Karsten 1866:211) (H, Karsten, Fungi Fenn. Exs. 775, LECTOTYPUS sec. Ju & Rogers 1996). **Sweden:** Jämtland: Åre Åreskutan 13 Aug 1982, *Salix*(w) AG s.n., GM 2367 (TROM). - Åsele Lappmark: Vilhelmina E of Djupdal Svältmyran 6 Jul 1986 GM 3712 (TROM).

Hypoxylon multiforme (Fr.: Fr.) Fr.

Summa Veg. Scand. 2: 384 (1849) - *Sphaeria multiformis* Fr.: Fr., Syst. Mycol. 2: 334 (1823), Obs. Mycol. 1: 169, Pl. 1, Fig. 2 (1815), K. svenska VetskAkad. Handl. 1816: 135 (1816). - *Sphaeria rubiformis* Pers., Usteri's Neue Annln Bot. 11: 20 (1794), Syn. Meth. Fung.: 9 (1801) - *Hypoxylon granulosum* Bull., Hist. Champ. Fr. 1: 176, Pl. 487, Fig. 2 (1791) - *Hypoxylon multiforme* (Fr.: Fr.) Fr. var. *granulosum* (Bull.) Fr., Summa Veg. Scand. 2: 384 (1849), non Saccardo (1882). - Anamorph: *Virgariella* (L.E. Petrini & Müller 1986).

Figs 22 A-D, 24 (map), 29-30 (stromata), 49 (SEM).

Description. *Stromata* 0.5-20 × 0.5-4 × 0.2-1 cm, on bark pulvinate, circular to elliptical, often coalescing to thick crusts, sometimes erumpent through the cork pores, on wood effused in elongate bands or large irregular crusts. Surface with strong perithecial contours. Young stromata with yellowish brown to rusty brown pruina, older stromata black, lacking the pulverulent covering. *Ectostroma* without pruina ca. 200 μm thick, hard, carbonaceous and brittle, inside shiny black. *Entostroma* basal part 1-8 mm, woody, coke grey with tiny grey spots at the base in young specimens. *Perithecia* 400-900 μm high, 350-600 μm broad, wall ca. 60 μm, consisting of an inner brown layer of *textura prismatica*, 9-15 μm thick, and an outer carbonized layer ca. 50 μm; globose or ovoid, uniseriate, with prominent, hemispherical elevations. Ostioles pronounced papillate, conical, occasionally with a thin, annular margin. *Asci* p.sp. 66-97 × 5.8-6.5 μm, m. 79 × 6.1 μm, st. 90-170 μm, m. 127 μm, amyloid with discoid annulus, 2-2.5 × 1-2 μm. Abnormal asci with *e.g.* two asci on the same stipe may occur. *Paraphyses* filiform, septate, unbranched or sparsely branched at the base, ca. 300 μm long, 3-4 μm broad, with yellow guttules. *Ascospores* 8-11.5 × 3-5 μm, m. 9.7 × 4.1 μm (n=200/10), inequilaterally ellipsoid, dull brown to terra-cotta (7D7), smooth, with 2 guttules and easily dehiscent perispore with a faint thickening toward one

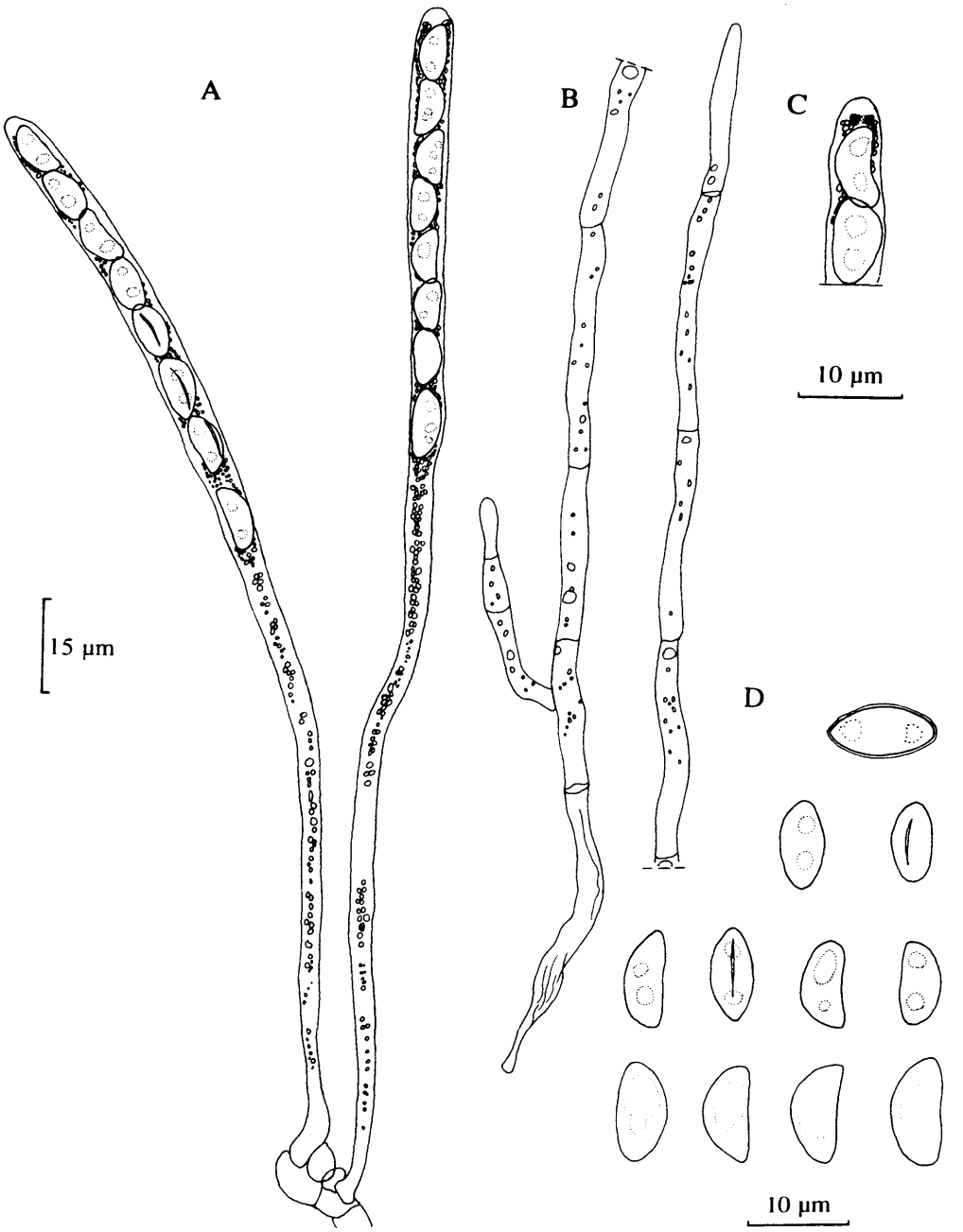


Fig. 22. *Hypoxylon multiforme*. A. Asci. B. Paraphysis. C. Ascus apex in MZ. D. Ascospores, the uppermost spore with perispore with small thickening. From BG 291.

end. Germ slit to 2/3 of spore-length on convex side.

Taxonomic notes. *Hypoxylon multiforme* is the type species of Miller's sect. *Papillata* (Miller 1961). Fries (1823: 334) erected the variety β. *granulosa* of *Sphaeria multiformis*, citing *Sphaeria granulosa* Pers. as the first synonym, followed by *S. mammiformis* Wahlenb. (1812) as the second synonym. These two species are *H. rubiginosum* (sec. L.E. Petrini & Müller 1986) and *Entoleuca mammata* (Wahlenb.) J.D. Rogers & Y.-M. Ju, respectively. Fries did never recombine var. β in *Hypoxylon*, but later (Fries 1849) coined *Hypoxylon multiforme* var. *granulosa* based on Bulliard's *H. granulosum*. Sommerfelt's (1826: 205) *Sphaeria mammiformis* Wahlenb. is a *Rosellinia* as seen from voucher specimen in O. Ju & Rogers (1996: 219) described the new variety *H. multiforme* var. *alaskense* on *Alnus* from Alaska. It is said to differ from the typical variety only in having larger ascospores (13-16 × 5-6.5 μm).

Ecology. *Hypoxylon multiforme* occurs on corticated and decorticated stumps, trunks and branches of a wide range of deciduous trees, but obviously prefers members of Betulaceae (*Betula*, *Alnus*), which are the main hosts in Norway as it seems they are everywhere else. Additional records were made on *Acer*, *Corylus*, *Fagus*, *Populus*, *Prunus*, *Quercus*, *Sorbus* and *Salix*. *H. multiforme* is especially abundant on decaying branches in humid habitats, preferentially growing on the underside. Though clearly a secondary saprobe, the fungus may at times appear as a wound parasite.

Distribution. *Norway*. *Hypoxylon multiforme* is the most common species of *Hypoxylon* in Norway, occurring throughout the country wherever hardwoods occur. *Total*. Sweden, Finland, Denmark, Iceland; all the North Temperate Zone (Miller 1961). It has not yet been recorded from Greenland. According to Miller (1961) the species is not recorded from the tropics, except at high altitudes, and not in the South Temperate Zone.

Differentiation. *Hypoxylon multiforme* is easy to recognize. However, when occurring on *Fagus* it may be confused with *H. cohaerens*, which has a more or less turbinate stroma. Vegetative stromata may be confused with vegetative *H. fuscum*, which, however, has brown entostroma and a non-carbonaceous, thin ectostroma. Thin, effused forms may be taken for a *Nemania*.

Comments. The first record of *Hypoxylon multiforme* from Norway was that by Wahlenberg (1812: 518) under the name *Sphaeria deusta* Hoffm. (UPS), collected in Finnmark during a botanical expedition in 1802. Sommerfelt (1826: 205, 1827: 44, as *Sphaeria multiformis*) stated it to be common in Saltdalen (No) and Schröter (1886: 210, 1888: 276) recorded it on *Betula* at Tromsø (Tr). *Hypoxylon multiforme* has later been reported in several papers.

Specimens examined. Norway: S.l.d.n.c. (O 222,234), *Alnus*(b) (O 37), id. *H. effusum* det. Rostrup (O 148) (Rostrup 1904:19), s.d. *Betula* S.C. Sommerfelt Plant. Crypt. Norv. I, fasc.2. 93. (1826) (O 147), s.d. N. G. Moe (O 35). - Øs: Askim: Rom 5 Jun 1933 *Sorbus*(b) A. Hagen (O 536). Kykkelsrud Nordbukta 3 Jul 1938 *Alnus incana*(b) A. Hagen (O 533). Fredrikstad: Torsnes Heierne 17 Apr 1931 *Betula* I. Jørstad (O 150). Gåsa 20 Jun 1935 *Sorbus*(b) A. Hagen (O 531). Near Fuglevik 24 Nov 1979 *Sorbus*(b) R. Kristiansen (O 534). Gansrød Sep 16 1994 *Betula* N. Lundqvist 19998 (S). Halden: Idd Bakke 17 Jun 1935 A. Hagen (O 530). Remmen 20 Sep 1975 A.-E. Torkelsen 400/75 (O 535). Hvaler: Søndre Sandøy 25 Apr 1975, 25-27 Apr 1975 A.-E. Torkelsen 10/75 (O 537,400), 25 Apr 1975 *Populus*(w) J. Stordal 16329 (O 447), 25-27 Apr 1975 *Betula*(b) F.R. Hansen (O 538).Moss: Jeløy Alby farm 30 May 1970 *Betula* A.-E. Torkelsen (O 149). Jeløy Bjørnåsen 31 Mar 1974 *Betula*(b) A.-E. Torkelsen 506/74 (O 532). - Ak: Asker: Nesøya 29 May 1879 A. Blytt (O 240). Nesøya at the head of Halsbukta 11 May 1962 *Sorbus*(b) F.-E. Eckblad (O 223). Hvalstad 5 May 1963 I. Egeland, G. Gulden & F.-E. Eckblad (O 153). Semsvannet 5 Jun 1971 *Betula*(b) A.-E. Torkelsen (O 545). Åstad between Hvalstad and Billingstad 13 May 1972 A.-E. Torkelsen 19/72 (O 160). Aurskog-Høland: Bjørkelangen 14 Sep 1974 *Alnus*(b) O. Balle (BG 302), id. *Betula*(w) E. Fremstad (BG 303). Bærum: Haslum 6 Jun 1927 *Betula*(b), *Sorbus aucuparia*(b) I. Jørstad (O 151,161). Øvre Voll 26 Oct 1928 *Prunus padus*(b) I. Jørstad (O 157). At Lysakerelva 3 Jun 1945 *Betula*(w) F.-E.

Eckblad (O 45). Between Kjaglia and Rognlia 10 May 1959 *Betula*(b) J. Stene (O 228). Jar 7 Jun 1962 J.A. Nannfeldt (O 152). Eidsvoll: At Eidsvoll church 13 May 1973 *Alnus incana*(b) A. Pedersen (O 164). Frogn: Langebåt near Drøbak 25 Sep 1837 F.C. Schübeler (O 154). Håøya 4 May 1991 *Betula*(b) A.-E. Torkelsen 18/91 (O 546). Lørenskog: S-end of Kjennvatnet 20 May 1962 *Betula*(w) F.-E. Eckblad (O 233). Nannestad: Tømte 2 Jul 1927 *Betula*(b) B. Lynge (O 156), 7 Sep 1934 *Alnus*(b) A. Hagen (O 543), 11 Sep 1974 *Alnus incana*(b) AG (BG 299), 13 Sep 1974 *Betula*(w) AG (BG 300). Viksvangen 5 Sep 1934 *Betula*(b) A. Hagen (O 544). Herstua Hære 24 Sep 1968 F.-E. Eckblad (O 224). Ski: Rullestad farm 4 May 1947 *Sorbus*(b) J. Stordal 24 (O 541). Ski church 12 Aug 1947 *Betula*(b) J. Stordal 733 (O 542). Skiseng 8 Oct 1972 *Sorbus aucuparia*(b) J. Stordal 15008 (O 448). Sørum: Kurland 200m N of Staurhaugen in Blaker 14 Sep 1974 *Alnus incana*(b) E. Fremstad (BG 301). Vestby: Åmot farm - Garder church 28 Apr 1976 *Sorbus*(w) A.-E. Torkelsen 351/76 (O 540). Ås: Nordby N of Askehaug 7 Apr 1957 J. Stordal 10808 (O 529). Bølstadbekken at Ås 11 Oct 1976 *Sorbus*(b) Chr. Johnsrud (BG 410). - Oslo: Kr.ania and surrounding area s.d.n.c. *Betula* p.p. (O 183,184), s.d. *Betula*(b) & *Alnus* M. N. Blytt (O 175,177), Feb 1840 & 1841 *Betula*(b) N.G. Moe (O 167), 1879 A. Blytt (O 192). Aker 1840 *Alnus* N. G. Moe (several capsules) (O 173). Bogstad s.d. *Prunus*(b) N.G. Moe (O 235). Ekeberg 8 Jun 1868 J.E. Zetterstedt (UPS). Bygdøy s.d.n.c. *Betula*(b) (O 188), s.d. *Betula*(bw) N.G. Moe (O 171). Kringsjå 10 Nov 1951 A. Bratsberg (O 170). Linderud s.d.n.c. (O 187). Ljabro Lutdalen 5 Jun 1927 *Salix*(b) I. Jørstad (O 163). Montebello s.d.n.c. (TRH 245), s.d. Blytt (O 199). Mærradalen s.d.n.c. *Betula*(b) (O 239), s.d. J. Egeland (O 238), Apr 1912 *Betula*(b) & *Prunus*(b) J. Egeland (O 181). Nordmarka Hakkloen 22 Sep 1879 *Sorbus* & *Betula*(b) A. Blytt (O 168,189). Rufsrud s.d.n.c. (O 186). Skøyen 1840 *Betula*(b) N.G. Moe (O 174). Slemdal at rivulet 27 Apr 1952 *Betula*(b) F.-E. Eckblad (O 225). Sogn s.d. Blytt (O 195). Sognsvann 27 Apr 1961 F.-E. Eckblad (O 178). Sognsveien 16 Sep 1967 *Sorbus aucuparia*(b) A.-E. Torkelsen (O 182). Tveten s. d. *Betula*(b) N.G. Moe (TRH 244). Tøyen s.d.n.c. (O 411), s.d. *Betula*(b) N.G. Moe (O 180), 1840 *Betula*(b) s.n.c. (TRH 241). Ullern s.d.n.c. *Hypoxylon atropurpureum* Fr. det. C.L. Shear (O 403), s.d. *Betula*(w) N.G. Moe *H. atropurpureum* Fr. det. C.L. Shear (O 404), s.d. *Betula*(b) & *Alnus*(b) M.N. Blytt (O 169,226). Voksen s.d. *Betula*(b) J. Thomle (O 198). Østensjø 17 Sep 1931 *Betula*(b) I. Jørstad (O 166). Østmarka at Trasop 3 Oct 1971 *Sorbus*(b) D. Hongve (O 159). Østre Gaustadmark 30 Jul 1962 *Sorbus*(w) F.-E. Eckblad (O 197). - He: Engerdal: Gutulia National Park 20 Jul 1971 *Betula*(b) G. Gulden 330/71 (O 202). Grue: Grinder 1 Nov 1929 *Betula*(b) p.p. I. Jørstad (O 205). Sæta 5 Jun 1979 *Alnus*(b) J. Stordal 19874 (O 501). Kongsvinger: Kongsvinger 14 Sep 1974 *Alnus*(b) O. Balle (BG 304). At the Hospital 12 May 1977 *Sorbus*(b) J. Stordal 18211 (O 496). Nes: Linnerud 1958 *Betula*(bw) A. Hjeltnes (O 229). Rendalen: Åsheim Hotel 3 Jun 1979 *Alnus*(b) J. Stordal 19858 (O 528). Ringsaker: Helgøya Bergsviken 30 Aug 1933 O.A. Høeg (TRH 242). Mesnali chapel "Oppistua" 5 Jul 1972 *Betula*(b) & *Alnus*(b) F.-E. Eckblad (O 436a,b). Greinåkermarka 12 May 1974 *Alnus*(w) J. Stordal 15341 (O 452). Moelv Skjelli 26 May 1974 *Betula*(b) J. Stordal 15366 (O 445). Helgøya Hovindsholm 2 Oct 1977 *Betula*(b) A.-E. Torkelsen 784/77 (O 506). Stange: Petlundhagan 7 Sep 1975 *Betula*(b) A.E. Torkelsen 350/75 (O 507). Stor-Elvdal: Evenstad Aug-Sep 1882 *Betula*(b) A. Blytt (O 41,201). Imsroa in spruce forest 16 Jul 1973 *Alnus* G. Gulden 668/73 (O 203). Åmot: Rena camping-ground 24 Sep 1976 *Alnus incana*(b) J. Stordal 17988 (O 497). Åsnes: Hoff in Solør 26 May 1931 *Alnus incana*(b) I. Jørstad (O 193). - Op: Dovre: Fokstua 1854 *Betula*(b) M.N. Blytt (O 207). Etnedal: Valdres Bruflat s.d.n.c. *Betula*(b) (O 54). Fron: Sikilsdalen slope above Prinsehytta 1050 m alt. 17 Jul 1976 *Betula pubescens*(b) E. Fremstad (BG 406). Gausdal: S of Snæreskampen 4 Sep 1970 *Betula*(b) H. Bøhler (O 200). Gjøvik: Bjørnvenskogen in Vardal 12 Oct 1969 S. Eie (O 208). Gjøvik at the skihut 12 Nov 1973 *Alnus incana*(b) J. Stordal 15320 (O 449). Diset at Biri 3 May 1974 *Alnus*(b) J. Stordal 15386 (O 441). Gjøvik estate 29 Mar 1975 *Alnus incana*(b) G. & K. Jenssen (O 471). Redalen between Roligfarm and the main road *Betula*(b) 18 Apr 1975 J. Stordal 16257 (O 498). Biri Svennes farm 10 May 1975 *Betula*(b) J. Stordal 16514 (O 495). Biri Honne 24 May 1975 *Sorbus*(b) A.-E. Torkelsen 81/75 (O 477). Biri Stumlia 25 May 1975 *Betula* A.-E. Torkelsen 99/75 (O 401). Biri Hegge 25 May 1975 *Betula*(b) A.-E. Torkelsen 114/75 (O 469). Biri outlet of Vismunda 6 Jun *Betula*(b) A.-E. Torkelsen 72/78 (O 478). Jevnaker: Vangsåsen 1 Jun 1969 *Betula*(b) G. Gulden 99/69 (O 206). Lillehammer: Fåberg Drotten 8 Jul 1972 *Alnus*(b) F.-E. Eckblad (O 438,510). Vingnes 19 Apr 1975 *Alnus incana*(bw) J. Stordal 16277 (O 493). Lunner: S. Oppdalen S of Storhaugen 23 Sep *Alnus incana*(b) E. Bendiksen (O 548). Nord-Aurdal: Midthavnen Jensestogo 28 Jun 1931 *Alnus incana*(b) A. Hagen (O 204). S. Jensestogobergene Jul 1931 *Betula*(b) A. Hagen (O 55). Aurdal Jul-Aug 1932 A. Hagen (O 57). Klosbøle 12 Jul 1932 *Alnus*(b) A. Hagen (O 42,53), 29 Sep 1933 *Alnus incana*(bw), *Alnus incana*(b) A. Hagen (O 486,554). Sislebekk 6 Oct 1933 *Alnus incana*(b) A. Hagen (O 472). Liabygden Søndre Åskjærbakkene 17 Aug 1934 *Betula*(b) A. Hagen (O 476). Møllerskogen above Gottenborgjordet 28 Apr 1935 *Betula*(b) A. Hagen (O 484). Sørskogen Dalen 16 Sep 1940 *Betula*(b) A. Hagen (O 209). Aurdal Gullhaug 25 Oct 1944 *Alnus*(b) A. Hagen (O 56). Håde at Leira 21 Jun 1972 F.-E. Eckblad (BG 386). Between Aurdal pension and river Begna 23 May 1976

Alnus incana(b) J. Stordal 17505 (O 439). Nordre Land: Lunde 25 Jun 1979 *Alnus incana*(b) J. Stordal 19894 (O 468). Ringebu: Ringebu s.d. *Betula*(b) S.C. Sommerfelt (O 36), s.d. *Alnus*(b) S.C. Sommerfelt (O 213), s.d. *Betula*(b) A. Blytt (O 219), May 1831 *Betula*(bw) *Sphaeria cohaerens* Fr. S.C. Sommerfelt (O 211) (Rostrup 1904:19 as *Hypoxylon cohaerens* (Pers.) Fr.), Aug 1838 *Alnus*(w) S.C. Sommerfelt (O 210). Ringebu Stuelikroen Apr 1840 *Betula*(b) F.C. Schübeler (O 212). Sel: Otta Ulvolden camping 15 Jul 1972 *Betula*(b) F.-E. Eckblad (O 437). Otta 1 Jul 1976 *Alnus*(b) J. Stordal 17542 (O 442). Fuglehjelle 15 Aug 1991 *Alnus*(b) A.-E. Torkelsen 155/91 (O 474). Søndre Land: Jønnes 15 Oct 1973 *Alnus incana*(bw) A.-E. Torkelsen (O 58). Nymoen 21 Oct 1982 *Alnus*(b) & *Prunus*(b) A.-E. Torkelsen 58/82, 59/82 (O 508,552). Sør-Aurdal: Below Kjyrkjebjørgo 29 Sep 1933 *Alnus*(b) A. Hagen (O 39). N of Odden 8 Aug 1934 *Alnus incana*(b) A. Hagen (O 470). Rustøe-vegen between Moen and Haugasagen 18 Aug 1934 *Alnus incana*(b) A. Hagen (O 473). Sør-Fron: S of Hundorp 1 May 1989 *Alnus incana*(b) A.-E. Torkelsen 106/89 & G. Gulden (O 522). Steberg S of Hundorp 13 May 1989 *Alnus* (b) G. Gulden 57/89 (O 509). Østre Toten: Above Kobberstadsætra in Hurdal 8 Aug 1928 *Alnus*(b) B. Lynge (O 155). Kapp Hensvoll farm 30 Apr 1977 *Corylus avellana*(b) J. Stordal 18132 (O 494). Forest E of Balke church 7 May 1977 *Alnus*(b) J. Stordal 18182 (O 440). Totenvika at Balke church 8 May 1977 *Alnus incana*(b) J. Stordal 18198 (O 467). Ø. Nettum 1 Oct 1977 *Alnus*(b) A.-E. Torkelsen 766/77 (O 513). Øyer: Bårdsengbekken in Baklia 5 km S of Tretten Aug 1972 *Betula*(w) AG (BG 1). Bjørge 16 May *Sorbus*(b) J. Stordal 19043 (O 511). - Bu: Drammen: Skoger Stordammen 15 May 1954 *Alnus*(b) F.-E. Eckblad (O 71). Hole: Krokkleiva tønneheis st. 19 Apr 1971 *Sorbus*(b) A.-E. Torkelsen (O 457). Sundvollen 29 May 1939 *Alnus*(b) O. Hanssen (O 59), 3 Jun 1973 *Betula*(b) J. Stordal 15186 (O 460). Vik 5 Jun 1966 *Betula* G. Gulden 122/66, 124/66 (O 60,61), 22 Jun 1967 *Betula*(b) G. Gulden 69/67 (O 64), 19 Apr 1971 *Betula*(b) s.n.c. (O 67). Kongsberg: Ø. Sandvær at Grønliseteren 31 May 1940 *Betula*(b) N. Brusli & E. Hadač (O 62). Meheia 16 May 1972 *Betula*(b) A.-E. Torkelsen 26/72 (O 66). Silver mines Skogskolen 14 Oct 1973 *Alnus*(b) J. Stordal 15274, 15275 (O 592,593). Krødsherad: Veikåker chapel 6 May 1973 *Corylus avellana*(b) & *Betula*(b) J. Stordal 15099, 15107 (O 443,459). Modum: Pilterudkløfta at Holsfjorden 2 Oct 1969 *Betula*(b) L. Ryvarden (O 65). Tannberg at Tyrifjorden 15 Sep 1974 *Betula*(b) I. Røsberg (BG 305). Heggen at Tyrifjorden 15 Sep 1974 *Alnus*(b) AG (BG 306). Nedre Eiker: Hagatjern-Stubberud 11 May 1969 *Betula*(b) G. Gulden 43/69 (O 63). Nes: Nesbyen Hallingdal museum 3 Oct 1965 *Betula*(b) I. Egeland (O 68. BG 385). Nore and Uvdal: Rødberg 16 Sep 1974 *Sorbus aucuparia*(b) AG (BG 309), id. *Betula*(b) O. Balle (BG 310), id. *Alnus*(b) A. Bertelsen (BG 311). Uvdal 16 Sep 1974 *Alnus*(w) A. Bertelsen (BG 312). Ringerike: Klekken at Kr.ania (!) s.d.n.c. *Betula*(b) (O 176). Nordmarken between Langlia and Opkuven 7 Jun 1908 *Betula*(b) B. Lynge (O 194). Rollag: Berg 2 km N of Rollag st. 16 Sep 1974 *Betula*(b) O. Balle (BG 307). Solhaug at Kulelia 3 km S of Djupdal st. 16 Sep 1974 A. Bertelsen (BG 308). Røyken: Slemmestad 18 May 1959 *Betula*(w) F.-E. Eckblad (O 221). Ål: Torpo church 17 Apr 1973 *Betula*(b) J. Stordal 15034 (O 458). - Ve: Borre: Borre church 28 Oct 1977 A.-E. Torkelsen 990/77 (O 462). Larvik: Larvik 1833 *Betula*(b) s.n.c. (O 69). Viksfjorden at Vikerøy 15 Apr 1968 *Betula*(b) G. Gulden 9/68 (O 72). Larvik Beech Forest 28 Jul 1974 *Fagus sylvatica*(w) AG 273/74 (BG 253). At Treschow-Fritzøe-plant 29 Jul 1974 *Betula*(b) AG (BG 252). Nøtterøy: Veierland Tangen 25 Jun 1975 *Betula*(b) A.-E. Torkelsen 318/75 (O 461). Veierland 2 Aug 1981 *Betula*(w) S. Aase (O 551). Våle: Langøya 8 Aug 1933 O.A. Høeg (TRH 243). - Te: Bø: Uvdal N of Gygrestolen 7 Jun 1974 *Betula*(b) O. Vevle (BG 377). Uvdalsheia N-side of Gygrestolen 27 Jul 1974 *Betula*(b), *Alnus*(b), *Prunus padus*(w), *Acer*(b) AG 230/74, 240/74, 237/74, 238b/74 & O. Vevle (BG 296a,b,c,d). Drangedal: Drangedal about 1km S of the rifle range 25 Jul 1974 *Betula*(b) & *Populus tremula*(bw) AG 204/74, 206/74 (BG 266a,b). 3km N of Tørdal church 15 Aug 1976 A.-E. Torkelsen 585/76 (O 463). Skultrevannsåsen 30 Aug 1977 *Betula*(b) A.-E. Torkelsen 445/77 (O 466). Kragerø: Kil 24 Jul 1974 *Betula*(b) AG 197/74 (BG 268). Kviteseid: Vrådal 25 Jul 1974 *Betula*(b) AG 208/74 (BG 289). Kviteseid 26 Jul 1974 *Betula*(b), *Alnus*(b), *Sorbus aucuparia*(b) AG 217/74, 211/74, 213/74 (BG 290a,b,c). Nome: Skordal 22 Aug 1974 *Alnus incana* O. Vevle (BG 378b), 1 Oct 1974 *Betula*(b) O. Vevle (BG 378a). Enggrav 8 Oct 1974 *Betula* O. Vevle (BG 379). Ulefoss Romness Jul 1977 *Betula*(b) O. Vevle (O 435. Notodden: Reskjemvatn 13 aug 1976 *Betula*(b) A.-E. Torkelsen 488/76 (O 465). Porsgrunn: Porsgrunn Jul 1840 *Alnus*(b) F.C. Schübeler (O 237). Håøya 17 May 1964 *Betula*(b) I. Egeland (O 75). Seljord: Seljord above the junior highschool 26 Jul 1974 *Betula*(b) & *Alnus incana*(w) AG 225/74, 220c/74 (BG 294a,b). Garvikstrand 13 Aug 1976 A.-E. Torkelsen 507/76 (O 464). Skien: Kirkemoene - Blåfjell s.d. *Betula*(b) J.M. Norman (O 514). Gjerpen 23 Feb 1964 *Sorbus*(b) K. Kvavik (O 76). Tinn: Above Rollag at Tin (= Mæl at Tinnsjøen) 22 Aug 1879 *Betula*(b) A. Blytt (O 73). Dale at Rjukan 23 May 1972 *Betula* A.-E. Torkelsen 153/72 (O 70). Tokke: Dalen 28 Jun 1973 L. Ryvarden 11875 (O 504). - AA: Arendal: Nedenes 7 Jun 1967 *Alnus incana*(b) L. Ryvarden (O 81). Fløystad 9 km N of Eydehavn 24 Sep 1967 *Betula*(w) S. Fløystad (O 77). Birkenes: Rislå 8 Aug 1958 *Betula*(b) J. Stordal 11291 (O 512). Bygland: Åraksbø Heddevikji 22 Jul 1974 *Betula*(b) AG 171/74 (BG 265). Evje og Hornnes: W of Bjørndalsvatnet 5 Jun 1979

Betula(b) A.-E. Torkelsen 239/79 (O 520). Gjerstad: Fiane Eikeland lake on the N-side of the road 3 May 1965 *Betula*(b) F.-E. Eckblad (O 74). Grimstad: S-end of Rorevatnet 1 May 1965 *Betula*(b) F.-E. Eckblad (O 78). Nørholm 20 Jul 1974 AG 139/74 (BG 272). Søm at Fevik 20 Jul 1974 *Fagus sylvatica*(w) AG 123/74 & K. Halvorsen (BG 273), 12 Jul 1995 *Fagus sylvatica*(b) AG 82/95 (TROM 598). Iveland: Nomelandsdammen 23 Sep 1977 *Betula*(b) A.-E. Torkelsen 654/77 (O 521). Lillesand: Eikelandsknuten 10 Jun 1975 *Betula*(b) A.-E. Torkelsen 232/75 (O 518). Tvedestrand: Holt 23 Jul 1974 *Betula*(b) AG 185/74 (BG 269). Songe 20 May 1977 *Betula*(w) A.-E. Torkelsen 70/77 (O 517). Åmli: 4 km N of Bøylefoss bridge 20 May 1977 *Betula*(b) A.-E. Torkelsen 121/77 (O 519). - VA: Farsund: Lista Tomstad Apr 1971 K. Høiland (O 82). Flekkefjord: W-side of Dipleknuten 23 Jun 1969 *Betula*(b) L. Ryvarden (O 79). Sira 15 Jul 1974 *Corylus*(b) AG 81/74 (BG 288). Gaupeland Havnehagen 20 Jul 1995 *Fagus sylvatica*(w) AG 185/95 (TROM 599). Kristiansand: Korsvik near Kristiansand 19 Jul 1974 *Alnus glutinosa*(b) & *Betula*(b) AG 104/74, 106/74 (BG 275,271). 2 km E of Ålefjær 23 Sep 1977 *Betula*(b) A.-E. Torkelsen 617/77 (O 516). Kvinesdal: Feda 16 Jul 1974 *Prunus padus*(w) & *Corylus*(w) AG 86/74, 87/74 (BG 270,274). Lindesnes: W of Opptun 21 Apr 1973 *Betula*(b) G. Gulden 569/73 (O 83). Vigeland 17 Jul 1974 *Salix*(w) AG 98/74 (BG 264). Lyngdal: Veggja 18 Apr 1973 G. Gulden 505/73 (O 80). - Ro: Bjerkreim: Ørsdalsvatn Dyrskog 29 Jul *Acer*(b) L. Ryvarden 17160 (O 523). Eigersund: Egersund 14 Jul 1974 *Corylus*(b) AG 80/74 (BG 284). Finnøy: Talgje May 1973 *Corylus*(b) Hagevold (BG 28). Gjesdal: Dirdal 13 Jul 1974 *Alnus*(b) AG 67a/74 (BG 285). Hjelmeland: Førre in Jøsenfjord 26 Jun 1967 *Betula*(b) L. Ryvarden (O 29), 30 Jun 1967 *Alnus*(w) L. Ryvarden (O 103). Hjelmeland 12 Jul 1974 *Corylus*(w) AG 59/74 (BG 286). Lund: E side of Rusdalsvannet 17 Jun 1969 *Betula*(w) L. Ryvarden (O 104). Sandnes: Høle Bjønnbåsen 21 Mar 1967 *Betula* P.M. Jørgensen (BG 381). Høle Hølesjøen 3 Aug 1967 *Alnus glutinosa*(b) P.M. Jørgensen (BG 380). Li 10 Apr 1979 *Betula*(b) O. Balle (BG 567). Sokndal: Jøssinghamn 17 Apr 1973 *Alnus*(b) G. Gulden 476/73 (O 86). Suldal: Kvilldal 30 Jul 1969 *Prunus padus*(b) L. Ryvarden (O 102). Sand Eide NE of folk high school 20 Jan 1973 *Alnus glutinosa*(w) J. Berge (BG 43). Sand 12 Jul 1974 *Prunus padus*(bw), *Alnus incana*(b), *Sorbus aucuparia*(b) AG 55/74, 46/74, 44/74 (BG, 281a,b,c). Hylsfjorden Hylen 25 Jul 1994 *Alnus incana*(b) AG 52/94 (TROM 575). Tysvær: Nedstrand Apr 1973 *Quercus*(w) S. Bakkevig (BG 21). - Ho: Askøy: Davanger Sep 1974 *Betula*(b) A. Bertelsen (BG 40). Bergen: Fjøsanger Langeskogen 25 Oct 1966 *Acer* R. Hvoslef (BG 88). Landås 10 Apr 1967 *Acer*(w) P.M. Jørgensen (BG 392), 24 May 1975 *Prunus padus*(bw) AG (BG 49). Storetveit 7 May 1972 O. Balle (BG 382). Loddefjord Oct 1972 *Betula*(b) B. Lundeberg (BG 2). Eikelund-Paradis 11 Mar 1973 *Betula*(b) & *Populus*(bw) O. Balle (BG 9,10). Sandalen 27 Apr 1973 J. Berge (BG 20). Arnatveit 20 May 1973 *Alnus*(b) S. Bakkevig (BG 22). Indre Arna Apr 1974 AG (BG 313). Stend Oct 1974 *Betula*(b) R. Hvoslef (BG 46). Skipenes in Fana 5 Jun 1975 *Fagus sylvatica*(b) K. Fægri (BG 389). Flaktveit 23 Nov 1986 *Betula*(w) S. Olsen (BG 560). Etne: Kyrping 11 Jul 1974 *Alnus incana*(b) AG 40/74 (BG 287). Fusa: Sundfjord, Forsåskaret 17 Oct 1971 *Betula*(b) D.O. Øvstedal (BG 383). Hålandsdal at Berge 20 Apr 1973 J. Berge (BG 26). Hålandsdal Kleive 12 Jun 1974 *Alnus*(b) I. Røsberg (BG 254). Granvin: Hillside at Eide railway st. 2 May 1948 *Alnus incana*(b) 2 coll. & *Sorbus aucuparia*(b) J. Stordal 1078, 1092, 1089 (O 525,527,550), 13 Jun 1948 *Betula*(b) J. Stordal 1154 (O 526). 200m W of Eide railway st. 2 May 1948 *Alnus incana*(b) (ass. with imm. *H. howeianum*) J. Stordal 1092 (O 527). Eide at river above the bridge 10 Jun 1948 G. Haglund (S). Kvanndal 7 Jun 1949 *Betula*(b) J. Stordal (BG 396). Folkedal 4 Apr 1950 *Prunus padus*(b) J. Stordal 3603 (BG 84). Lussand W of Kvanndal 3 Aug 1972 F.-E. Eckblad (BG 360). Granvin hillside 200m E of outlet of river 8 Jul 1974 *Betula*(b) & *Sorbus aucuparia*(bw) AG 7/74, (BG 260a,b). Jondal: Solesnes 20 May 1972 *Betula*(b) A.-E. Torkelsen 61/72 (O 91). Svåsand 20 May 1972 *Sorbus*(b) A.-E. Torkelsen 68/72 (O 94). Kvam: Strandebarm below Åse 20 May 1926 *Betula*(b) T. Lillefosse (O 97). Mundheim 25 Mar 1973 *Betula*(b) J. Berge (BG 11). Hatlestrand Grønevik 4 Nov 1973 *Alnus glutinosa*(bw) J. Berge (BG 33). Omastrand 1977 *Alnus*(b) W. Holm (BG 570). Kvinnherad: Løfallstrand 12 Feb 1972 *Betula*(b) F.-E. Eckblad (BG 44). Bondhusdalen NW-end of Bondhusvatnet 28 Jun 1974 *Betula pubescens*(b) E. Fremstad & E. Fotland (BG 390). Lindås: Grimstad S of Hundvin Oct 1972 *Alnus glutinosa*(b) AG (BG 3,4), 20 Sep 1973 *Alnus*(b) (ass. with *Polydesmia pruinosa*) AG (BG 257). Vågseidet 23 Mar 1973 *Betula*(w) AG (BG 27). Munndalsberg 6 Jun 1974 *Betula*(b) O. Balle (BG 255). Odda: Odda Bustetun 8 Jun 1949 *Betula* J. Stordal (BG 395). Odda 10 Jul 1974 *Betula*(b), *Alnus glutinosa*(b), *Salix*(w) AG 32/74, 34/74, 38/74 (BG 276a,b,c). Skarde Tveit -Reinsnos 15 Jul 1971 *Betula* A.-E. Torkelsen (O 95). Skjelvik 21 May 1972 *Alnus* A.-E. Torkelsen 102/72 (O 87). Skarde 22 May 1972 *Sorbus* A.-E. Torkelsen 114/72 (O 85). Espelandsmarka at Trestøl 20 Jul 1973 *Betula* A.-E. Torkelsen 63/73 (O 96). Os: Hattvik 22 Apr 1969 O. Vevle & D.O. Øvstedal (BG 363). Hegglandsdalen Øvre-Eide 20 Apr 1972 *Alnus incana* J. Berge (BG 365). Halgjem 8 Apr 1973 F.-E. Eckblad (BG 366). Bjørnen 8 Apr 1973 *Alnus glutinosa*(b) & *Alnus*(b) I. Røsberg (BG 13,14), id. *Prunus padus* AG (BG 12). Os 31 May 1973 *Betula pubescens*(b) I. Røsberg (BG 25). Nordstrøno 9 Jun 1973 L. Ryvarden (O 31). Lønningdal Øyri 29 May 1974 *Betula*(b) E. Fremstad (BG

364). Røttingen 12 Oct 1980 *Alnus*(b) B.F. Moen (BG 559). Osterøy: Kosdalen 15 Apr 1967 *Alnus*(b) D.O. Øvstedal & O. Vevle (BG 220), 11 Nov 1973 *Alnus glutinosa*(b) O. Vevle (BG 32). Samnanger: Årland 9 Jun 1973 J. Berge (BG 38). Stord: Stord Sævarhagviki 30 Jun 1966 *Alnus glutinosa*(b) E. Fremstad (BG 405). Sund: Berge 25 May 1974 *Betula*(w) I. Røsberg (BG 256). Sveio: Mølstre-Vandaskog 11 Jun 1969 *Salix* L. Ryvarden (O 92). Kvalvåg Langaneset 17 Jul 1988 *Betula*(b) D. Moe (BG 563). Ullensvang: Jåstad 31 May 1971 *Betula*(b) A.-E. Torkelsen (O 524). Måge 18 May 1972 *Sorbus*(b) A.-E. Torkelsen 29/72 (O 90). Brattespe 21 May 1972 *Betula*(b) A.-E. Torkelsen 83/72 (O 89). Djupedal at Børve 21 May 1972 *Betula* A.-E. Torkelsen 91/72 (O 93). Kinsarvik Husedalen 21 May 1972 *Alnus*(b) A.-E. Torkelsen 77/72 (O 98). Lofthus 9 Jul 1974 *Betula*(b) & *Alnus incana*(bw) AG 29/74, 28/74 (BG 279a,b). Kinsarvik 18 Jan 1975 *Betula*(b) O. Befring (BG 361), 30 May 1976 *Alnus incana* A. Skogen (BG 388). Ulvik: Åsrygg E of Hjeltnes 7 Aug 1951 *Alnus incana*(b) J. Stordal 4741 (BG 362). Ulvik 200m NW of Ulvik Camping at old sawmill 9 Jul 1974 *Alnus incana*(w) AG 25/74 (BG 263). Voss: Tveito in Bordalen 14 Apr 1949 *Alnus*(b) J. Stordal 2189 (O 553). Hillside above Voss railway st. 8 Jul 1974 *Alnus*(w) AG 3/74 (BG 259). - SF: Askvoll: Askvoll 30 Aug 1972 F.-E. Eckblad (BG 605), 15 Oct 1976 *Betula* E. Jensson (BG 409). Aurland: Vinjum 15 Jun 1949 *Betula* J. Stordal (BG 397). Flåm Fretheim 24 Apr 1952 *Alnus incana*(b) J. Stordal 7327 (BG 371). Vassbygdi Midjedalen s.d. D.O. Øvstedal (BG 384). Gudvangen 1km N of ferry station on W-side 23 Mar 1975 *Alnus*(b) E. Fremstad (BG 48). Balestrand: Dragsvik 10 Sep 1975 AG (BG 394). Mundal 5 Jun 1987 *Alnus*(b) O.J. Befring 702 (BG 571). Eid: Nordfjordeid 10 Jul 1973 *Betula*(b), *Alnus incana*(w), *Sorbus aucuparia*(w), *Prunus padus*(b) AG 20/73, 19/73, 26/73, 27/73. (BG 317a,b,c,d). Flora: Svanøy Erikstad Sep 1897 *Betula*(b) C. Størmer (O 99). Eikefjord 10 Jul 1973 *Betula*(b) & *Sorbus*(b) AG 1/73, 2/73 (BG 314a,b). Førde: Moskog 19 Jun 1972 *Betula* O. Balle (BG 373). SW of Moskog road fork 10 Jan 1974 *Betula* O. Befring 363 (BG 367). N-side of Grøningstølsvatnet 600m alt. 21 Jun 1975 *Betula*(b) I. Røsberg (BG 370). Gloppen: Austrheim at road fork W of Sandane 22 Apr 1968 O. Befring 244 (BG 369). Hyen 10 Jul 1973 *Betula*(b) & *Alnus incana*(b) AG 8/73, 11/73 (BG 315a,b). Lote 10 Jul 1973 *Betula* & *Alnus*(b) AG 14/73 (BG 316a,b). Hyllestad: Leirvik Kletten 13 Oct 1974 *Betula* O. Aas, 30 Aug 1976 O. Aas (BG 418,408). Jølster: Befring 280m alt. 13 Nov 1962 *Betula*(bw) O. Befring (O 109), 24 Sep 1972 *Betula*(b) O. Befring, 30 Oct 1972 *Prunus padus*(w) O. Befring (BG 6,5), 16 Jul 1974 on fence poles O. Befring 376 (BG 372), 25 Apr 1982 *Alnus*(b) O.J. Befring 702 (BG 572). Kjøsnesfjorden Ripe 14 Jan 1973 *Alnus incana*(bw) O. Befring (BG 7). Kjøsnesfjorden under Skafonnfjellet 7 May 1986 *Corylus*(b) O.J. Befring 590 (BG 564). Skei Fygle 22 Jan 1973 *Betula*(b) O. Befring (BG 8). Skei in the hotel garden, 19 Mar 1974 *Acer*(w) O. Befring 366 (BG 368). Leikanger: Hallandsberget 20 Mar 1975 *Betula*(bw) O. Aas, 30 Mar 1975 *Alnus incana*(b) O. Aas (BG 565,566). Leikanger above Frækaland farm 28 Jul 1975 *Alnus incana*(b) O. Aas (BG 50). Kvinna 3 km E of Hella 22 Jul 1994 *Betula*(w) AG 25/94 (TROM 576). Ramnaberg 23 Jul 1994 *Betula*(w) AG 37/94 (TROM 574). Sogndal: Hillside E of Sogndal church 25 May 1973 *Sorbus aucuparia*(w) & *Alnus incana*(b) J. Stordal 15133, 15140 (O 446,480). Kaupanger ferry station 26 May 1973 *Corylus avellana*(b) J. Stordal 15181 (O 481). Stryn: Between Folven and Hjelle 31 Jul 1972 *Betula*(w) A.-E. Torkelsen 319/72 (O 108). Oppstryn 31 Jul 1972 *Betula*(w) & *Sorbus*(b) A.-E. Torkelsen 329/72, 331/72 (O 105,215). Varberg 1 Aug 1972 *Betula*(b) A.-E. Torkelsen 340/72 (O 106). Loen 13 Aug 1974 *Corylus avellana*(b) O. Balle (BG 391). Kjenndalen 13 Aug 1991 *Alnus*(w) A.-E. Torkelsen 70/91 (O 479). Vik: Vik towards peninsula 16 Jun 1950 *Corylus*(b) J. Stordal 4036 (O 110). Vågsøy: Vågsøy Måløy 2 Oct 1975 *Sorbus*(b) AG 167/75 (BG 51). - MR: "Sunnmøre" s.d. K. Bjørlykke (O 114). Frei: Near Kvernberget airport 5 Aug 1974 *Betula*(b) A.-E. Torkelsen 784/74 (O 482). Nesset: Øverås 14 Jul 1973 *Alnus incana*(b) AG 66a/73 (BG 322). Norddal: Eidsdal Kilsti 30 Jul 1972 *Betula*(w) A.-E. Torkelsen 294/72 (O 115). Eidsdal 12 Jul 1973 *Alnus incana*(b) AG 45/73 (BG 320). Rauma: Åndalsnes 13 Jul 1973 *Betula*(b), *Alnus incana*(bw) & *Sorbus aucuparia*(b), *Prunus padus*(b) AG 53/73, 50/73, 57/73, 60/73 (BG 321a,b,c,d). Sande: Breivik Larsnes 4 Jul 1975 *Betula* O. Balle (BG 374). Stranda: Hellesylt 12 Jul 1973 *Alnus incana*(bw) & *Sorbus aucuparia*(bw) AG 40/73, 38/73 (BG 318a,b). Geiranger 12 Jul 1973 on fence pole AG 41/73 (BG 319). Sula: Sulesund 30 Mar 1973 *Alnus glutinosa*(b) I. Røsberg (BG 47). Sunndal: Sunndalsøra 15 Jul 1973 *Alnus incana*(b) AG 70/73 (BG 323). Øksendal 3km S of the church 2 Aug 1974 *Betula* A.-E. Torkelsen 667/74 (O 399). Sogge bridge 20 Aug 1991 *Alnus incana*(b) A.-E. Torkelsen 293/91 (O 488). Vestnes: Tresfjord 7 Apr 1971 *Alnus*(b) J.N. Kristiansen (TRH 558). Volda: Dalsfjorden Løvik May 1967 *Alnus*(bw) T. Kavlie (O 107). Ørsta: Ørstavik 11 Aug 1952 *Prunus padus*(b) A. Linge (O 101). Ålesund: Aksla 15 Apr 1973 *Betula* I. Røsberg (BG 17). Gangstøvika 15 Apr 1973 I. Røsberg (BG 16). Nørvevika 15 Apr 1973 *Betula*(b) I. Røsberg (BG 15). Leirstad 7 Jun 1991 *Betula*(w) A.-E. Torkelsen 28/91 (O 483). - ST: Klæbu: Hyttfossberga 1 Apr 1975 *Corylus avellana*(b) T. Klokk (TRH 556). Malvik: Hommelvik 11 May 1974 *Betula*(b) (TRH 555). Meldal: Storås 21 Apr 1973 *Alnus incana*(bw) E. Fremstad (BG 19). Melhus: Hovin near Gaula bridge 1 Oct 1933 O.A. Høeg (TRH 247). Lundamo Ulåsøra 7 Jul 1975 *Prunus padus*(b) I. Røsberg (BG 376). Midtre Gauldal: Singsås Kotsøy 12 Aug 1971

Betula(b) A.-E. Torkelsen (O 112,113). Støren 16 Jul 1973 *Alnus incana*(b) AG 92/73 (BG 326). Soknedal 7 Jul 1975 T. Kummen (BG 375). Oppdal: 'Dovre' s.d.n.c. *Betula*(b) (O 52, TRH 251). Drivstuen 13 Jun 1864 Th. M. Fries *H. multiforme* var. (UPS 414, herb. E. Fries). Oppdal 15 Jul 1973 *Betula*(b) AG 76/73 (BG 324). Orkdal: Rønningen 1 km W of Svorkmo 19 Jul 1973 *Alnus incana*(b) E. Fremstad (BG 258). Rennebu: Berkåk 16 Jul 1973 *Betula*(b) AG 88/73 (BG 325). Rissa: Enebakk 18 Jul 1973 *Betula*(b) & *Alnus incana*(b) AG 105/73, 104/73 (BG 327a,b). Trondheim: Foldal at Klæbuveien 4 Dec 1932 O.A. Høeg (TRH 249). Leinstrand Ringvål-Loglo 24 May 1936 *Betula*(b) O.A. Høeg (TRH 248). Nedre Leirfoss E-side above the waterfall 2 Feb 1937 O.A. Høeg (TRH 250). Jonsvatnet May 1973 *Prunus padus*(w) (23) T. Søreng (BG 23,24). Hønvaldet 4 May 1975 *Alnus incana* S. Sivertsen (TRH 398). - NT: Grong: Namdalen Fjerdingen 1 Aug 1971 *Alnus*(w) A.-E. Torkelsen (O 214). Sandøla W of Finnkrufossen alt. 200m 18 Sep 1972 *Alnus* Å. Strid 11500 (Strid 1975: 46) (S). Levanger: Frol Buran-Rotåsen 13 Oct 1968 *Betula*(b) J. Stordal 12899 (O 499). Borgsåsen 3 May 1970 *Alnus*(b) J. Stordal 13240 (O 500). S slope of Borgsåsen 25 Apr 1971 *Alnus incana*(b) J. Stordal 13808 (O 444). Lierne: Between the lakes Kvesjøen and Murusjøen alt. 320m 18 Sep 1972 *Alnus* Å. Strid 11630 (Strid 1975: 46) (S). Meråker: At river Kopperåa near Turifossen alt. 200-220 m 14 Sep 1972 *Alnus* Å. Strid 11081 (Strid 1975: 46) (S). Namdalseid: Sjøåsen 19 Jul 1973 *Betula*(b) & *Alnus*(bw) AG 115/73, 116/73 (BG 329a,b). Namsos: Toddum 9 May 1971 *Betula*(b) J. Stordal 13853 (O 451). Prestegardsskogen 21 Apr 1972 *Alnus incana*(b) J. Stordal 14439, 14446 (O 491,492). Gullvikstranda 1 May 1972 *Alnus incana*(w) J. Stordal 14490 (O 490). Namsskogan: Namskogen W bank of Mellingselva alt. 220 m 12 Oct 1972 Å. Strid 13077 (Strid 1975: 46) (S). Overhalla: Skage Vanebu 31 May 1970 *Alnus incana*(b) J. Stordal 13290 (O 489). Røyrvik: Sagviken 15 Sep 1968 J. Stordal 12708 (O 450). Snåsa: W of Berg 25 Jul 1968 *Betula*(b) E. Roll-Hansen (O 100). Vegset 1 Aug 1971 *Betula*(b) & *Alnus glutinosa* A.-E. Torkelsen (O 120,216). Bruvoll river near its outlet into N-part of Snåsavatnet alt. 30-50 m 16 Sep 1972 *Alnus* Å. Strid 12772 (Strid 1975: 46) (S). Bergsåsen 20 Jul 1973 *Alnus incana*(w) AG 124/73 (BG 331). Steinkjer: Steinkjer 12 Aug 1971 *Betula*(b) & *Sorbus*(b) A.-E. Torkelsen (O 111,218), 19 Jul 1973 *Alnus incana*(bw), *Sorbus aucuparia*(b), *Prunus padus*(b) AG 122/73, 121/73, 120/73 (BG 330a,b,c). Stjørdal: Skatval Hollan 8 Jul 1945 O.A. Høeg (TRH 246). Stjørdalshalsen Husbymyr 15 Apr 1973 *Alnus incana*(bw) E. Fremstad (BG 18). Verdal: Verdalsraset Vestmælingen E of Mo 20 Jun 1938 *Alnus incana*(w) A. Hagen (O 487). Verran: Malm 19 Jul 1973 *Sorbus aucuparia*(b) AG 110/73 (BG 328). - No: Bodø: SE of Vågøy Experiment Farm 5 May 1968 (various woods) H. Andersen (O 126). Skarmofjell SW slope 18 May 1975 *Betula*(w) H. Andersen (TROM 585). Soløyvatnet 25 May 1975 *Alnus*(w) H. Andersen (TROM 584). Grønåsen Jensvold 10 Jul 1988 *Prunus padus*(w) D. Moe (BG 569). Evenes: Liland 26 Jul 1973 *Alnus incana*(bw) AG 177/73 (BG 344). Forra Forraheia 28 Jul 1973 *Betula*(bw) Gj. Jenssen (BG 345). Forra Brenna 29 Jul 1973 *Alnus incana*(b) & *Prunus padus*(w) AG 188/73, 190/73 (BG 346a,b), 31 Mar 1974 *Betula*(w) AG & F.V. Granmo (TROM 425), 5 May 1974 *Betula*(w) AG (TROM 425,430). Forra Huggevik 7 Jun 1981 *Alnus*(b) S. Dunfjeld, GM & AG 74/81 (TROM 583). Botn Hallerens S-side 17 Sep 1995 *Populus tremula*(w) AG 230/95 (TROM 601). Fauske: Straumen road fork 3 Aug 1971 *Betula*(w) A.-E. Torkelsen (O 121). Leivset 23 Jul 1973 *Betula*(w) AG 157/73 (BG 338). Grane: Trofors at the railway station 20 Jul 1973 *Betula*(b) & *Alnus incana*(bw) AG 129/73, 128/73 (BG 332a,b). Hamarøy: Between Tømmerneset and Fjelltun 9 Aug 1971 *Betula*(b) A.-E. Torkelsen (O 117). Innhavet 25 Jul 1973 *Betula*(bw) & *Alnus incana*(b) AG 168/73, 167/73 (BG 341a,b). Hattfjelldal: Hattfjelldal E of the church 21 Jul 1973 *Betula*(b) AG 131/73 (BG 333). Hemnes: Korgen Kangsen 27 Aug 1969 *Betula*(b) L. Ryvarden (O 122). Bjerka 14 Oct 1972 *Alnus incana* Å. Strid 13222 (S 603). Finneidfjord 22 Jul 1973 *Betula*(bw), *Alnus incana*(bw), *Sorbus aucuparia*(b) AG 140/73, 141/73, 139/73 (BG 335a,b,c). Lødingen: Lødingen 25 Jul 1973 *Betula*(w) AG 174/73 (BG 343). Narvik: Bjerkvik 4 Aug 1971 *Betula*(w) A.-E. Torkelsen (O 119). Skjomen Forsheim 12 Aug 1974 *Alnus incana*(b) AG, 1 Oct 1994 *Alnus incana*(b) AG (TROM 578,562). Skjomen Klubbvik 18 Oct 1979 *Sorbus*(w) AG 458/79 (TROM 581), 29 Aug 1981 *Alnus*(w) GM (TROM 580). Rana: 'Ranen' s.d.n.c. *Betula*(b) (O 129). Nord-Rana between Røsvollnes and Nevermoen 3 Aug 1971 A.-E. Torkelsen (O 118). Dunderlandsdalen 3 km E of Bjøllånes 3 Aug 1971 *Betula*(b) A.-E. Torkelsen (O 123). Dunderland at the railway st. 22 Jul 1973 *Betula*(w), *Alnus incana*(w) AG 146/73, 148/73 (BG 336a,b). Hammernes 8 Sep 1976 *Betula*(b) A.-E. Torkelsen 659/76 (O 503). St. Alteren 10 Sep 1976 *Prunus padus*(w) J.A. Nannfeldt 24370 (UPS 417). Ørtfjellmoen 11 Sep 1976 *Betula*(b) A.-E. Torkelsen 754/76 (O 502). Saltdal: Saltdalen s.d. *Betula*(b) 2 coll. *Sphaeria cinereofusca* Schum.: *multiformis* Fr. b. *coarctata* Fr. S.C. Sommerfelt (O 135,138) (Sommerfelt 1826: 205; 1827: 44), s.d. *Alnus*(b) *Sphaeria multiformis* aa *rubiformis* Fr. S.C. Sommerfelt (O 137) (Sommerfelt op. cit.), Oct 1818 *Alnus Sphaeria argillacea* Fr. S.C. Sommerfelt (O 128), Sep 1819 *Alnus incana*(b) *Sphaeria multiformis* cc. *effusa* Fr. S.C. Sommerfelt (Sommerfelt 1827: 44) (O 136), May 1823 *Alnus incana*(b) *Sphaeria multiformis* aa. *rubiformis* Fr. S.C. Sommerfelt (O 125). Junkerdalen 30 Jun 1966 *Betula* G. Gulden (O 116), 10 Aug 1971 *Betula*(b) A.-E. Torkelsen (O 127). Rognan 10 Aug 1971 A.-E. Torkelsen

(O 217). Røkland 23 Aug 1973 *Betula*(bw) & *Alnus incana*(b) AG 150/73, 152/73 (BG 337a,b). Nestby 7 Sep 1980 AG & S. Dunfjeld (TROM 589). Skjerstad: Kykkelsvatnet 20 Jul 1985 *Betula*(w) D. Moe (BG 561). Steigen: Engeløy Laskestad 8 Aug 1975 *Betula*(b), *Sorbus aucuparia*, *Corylus*(bw) AG 86/75, 76/75, 85/75 (BG 353a,b,c). Sørfold: Sommarset 24 Jul 1973 *Betula*(bw) AG 162/73 (BG 339). Bonåsjøen 24 Jul 1973 *Alnus incana*(b) AG 165/73 (BG 340). Tysfjord: Bognes 25 Jul 1973 *Betula*(b) & *Alnus incana*(b) AG 173/73, 172/73 (BG 342a,b). Vefsn: Mosjøen E of Railway st. 21 Jul 1973 *Betula*(w), *Alnus incana*(bw), *Prunus padus*(bw) AG 137/73, 138/73, 136/73 (BG 334a,b,c). - Tr: Balsfjord: Nordkjosbotn 7 Aug 1971 *Betula*(w) A.-E. Torkelsen (O 133). Selnes Knausen N of Myrli 21 Aug 1976, *Alnus*(w) 2 coll. O. Skifte, 23 Jun 1980 *Alnus*(b) O. Skifte (TROM 594,595, 591). Bardu: Bardu 1891 *Betula*(w) A. Blytt (O 131). Salangsdalen Brattli 5 Aug 1971 *Betula*(b) A.-E. Torkelsen (O 134). Setermoen 31 Jul 1973 *Betula*(b), *Alnus incana*(w), *Sorbus aucuparia*(b) AG 192/73, 194/73, 196/73 & Ingfrid Granmo (BG 347a,b,c). Setermoen at Barduelva 16 Sep 1995 *Prunus padus*(w) AG 219/95 (TROM 602). Gratangen: At Gratangen Tourist station 7 Aug 1971 *Betula* A.-E. Torkelsen (O 132). Ibestad: Rolla 20 Jul 1976 *Alnus incana* D.O. Øvstedal (BG 407). Kvænangen: Kvænangsbotn 3 Aug 1973 *Betula*(bw) & *Alnus incana*(bw) AG 229/73, 226/73, 228/73 & Ingfrid Granmo (BG 351a,b). Kåfjord: Olderdalen 2 Aug 1973 *Alnus incana* AG 212/73 & Ingfrid Granmo (BG 349). Ankerlia 18 Aug 1992 (Mathiassen & Granmo 1996: 44) (TROM). Lyngen: Øvre Karnes Leine 27 Sep 1964 *Alnus*(b) O. Skifte & S. Sivertsen (TROM 422). Lyngseidet 2 Aug 1973 *Betula*(b) & *Alnus incana* AG 204/73, 209/73 & Ingfrid Granmo (BG 348a,b). Målselv: Kirkesnes s.d. *Betula*(w) (232) J.M. Norman (O 130,232). Moen s.d. *Betula*(b) J.M. Norman (O 231,236). Frihetsli 17 Sep 1965 *Betula*(b) O. Skifte 411/65, 24 Sep 1966 *Betula*(b) O. Skifte (TROM 579,427). Fosshøgda 21 Aug 1977 O. Skifte 50-51/77 (TROM 582). Nordreisa: Sappen 14 Aug 1968 *Betula*(b) L. Ryvarden (O 505). Javrreoaive 19 Aug 1968 *Betula* P.M. Jørgensen 2484 (BG 387). Sørkjosen 3 Aug 1973 *Betula*(b) AG 217/73, *Alnus incana*(bw) AG 218/73, *Prunus padus*(b) AG 216/73 & Ingfrid Granmo (BG 350a,b,c). Skånland: At Revvatnet 27 Jul 1975 AG (BG 354). Skoddebergvatn 2 km S of Annamoen 1 Apr 1994 *Betula*(w) AG & L. Mølster (TROM 577). Storfjord: Skibotn Helligskogen 17 Aug 1992 *Betula* (Mathiassen & Granmo 1996: 44) (TROM). Skibotn Lullesletta 25 Aug 1996 *Populus tremula*(w) (ass. with *Nemania serpens*) *Prunus padus*(b) AG 26/96, 28/96 (TROM 604, 605). Tromsø: Sørbotn in Mellomdalen 7 Aug 1971 *Betula*(b) A.-E. Torkelsen (O 124). Tromsøya Folkeparken at the Museum 29 Apr and 10 May 1974 *Betula*(w) AG (TROM 426,428). Tromsdalen 2 km inwards 4 Jun 1979 *Alnus*(w) AG (TROM 586). Tromsøya Grønåsen 17 Aug 1979 *Betula*(w) AG (TROM 587). Ramfjord Kalvebakken 19 Apr 1980 *Alnus*(b) S. Sandvik & A. Elvebakk (TROM 588). Kaldslett 100 m alt. 2 Apr 1995 *Alnus*(b) AG (TROM 597). Kvaløya Teigen 9 Aug 1995 *Betula*(b) AG & GM (TROM 600). - Fi: Alta: Alta Smedegjerdet s.d. *Betula*(b) J.M. Norman (O 227,230). Bossekop s.d. [1841] N.G. Moe (O 402). Mattisdalen 27 Aug 1967 *Prunus padus*(b) L. Ryvarden (O 139). Talvik Storvatnet 1 Sep 1967 *Betula* L. Ryvarden (O 34). Seiland [Store]Bekkarfjord 25 Jul 1968 *Betula* L. Ryvarden (O 142). Slope Flintfjellet - Haldde 2 Aug 1968 *Alnus*(b) O. Skifte 33/68 (TROM 429). Aronnes at Elvebakken 25 Aug 1969 *Betula*(b) L. Ryvarden (O 30). Eibydalen Goskamark forest reserve 23 Aug 1970 *Sorbus*(b) L. Ryvarden (O 143). Eibydalen Kløftan 4 Aug 1973 *Betula*(b) & *Alnus incana*(w) AG 248/73, 237/73 & Ingfrid Granmo (BG 355a,b). Karasjok: Karasjok 18 Jul 1961 *Betula*(b) F.-E. Eckblad (O 145). Customs station 24 Aug 1969 L. Ryvarden (O 141). Kautokeino: Masi 12 Aug 1968 *Betula*(w) G. Gulden 314/68 (TROM 590). Lebesby: Guorgabmir at Stuorajokka ca. 15 km S of Kunes 28 Jul 1965 *Betula*(b) L. Ryvarden (O 146). Nesseby: Nyborg s.d. *H. granulosum* Bull. (effused form on wood) Th.M. Fries (UPS 415, herb. E. Fries), 1858 Chr. Sommerfelt (UPS 413, herb. E. Fries). Meskelva 16 Jul 1968 *Betula*(b) L. Ryvarden (O 140). Porsanger: Lakselv Banak 19 Jul 1961 *Betula* F.-E. Eckblad (O 144). Lakselv 6 Aug 1973 *Betula*(bw) AG 256/73 (BG 356). Russenes 6 Aug 1973 *Betula*(w) AG 252/73 (BG 357). Sør-Varanger: Kirkenes Bjørnevatn 9 Aug 1973 *Betula*(w) AG 279/73 (BG 359). Pasvik Brattli 12 Aug 1980 *Betula*(w) AG (TROM 573). Tana: Polmak s.d. [1802] *Betula alba*(b) G. Wahlenberg '*Hypoxylon*, *Sphaeria deusta* Whl. Lapp. An *H. multiforme*' (E. Fries scrips.) ded. Wahlenb. (UPS 416, herb. E. Fries) (Wahlenberg 1812: 518 as *Sphaeria deusta*). Tana bridge at the outlet of Seidajokka 8 Aug 1973 *Betula*(w) AG 268/73 (BG 358). - *References*. NT: Levanger: W of Østborg alt. 30-50 m 16 Sep 1972 *Alnus* (Strid 1975: 46). - No: Grane: Kløvimoen 8 km E of Trofors alt. 150m 8 Oct 1972 *Alnus* (Strid l.c.). Hattfjelldal: Just N of Unkervatnet alt. 330 m *Alnus* (Strid l.c.). Vefsn: Mosjøen Gildevangen alt. 30-50m 13 Oct 1972 *Alnus* (Strid l.c.). - Tr: Tromsø: Tromsdalen 28 Jul 1885 *Betula* (Schröter 1886: 210, 1888: 276). **Germany:** Westfalen Wolbeck b. Münster s.d. Nitschke as *H. crustaceum* (Sow.) N., but at first(?) as *H. serpens* (it is *H. multiforme* partly covering old stromata of *H. fuscum* on *Betula*(w)) (B). S.l.d. 'N.W.5' as *H. crustaceum* (Sow.) N. (the same as the preceeding, but possibly on *Corylus*) (B). **Country unknown:** Ex herb. Persoon as *Sphaeria atropurpurea* Fr. (L 910.270-277); as *Sphaeria rubiformis* (L 910.269-437, TYPE sec. Miller 1932: 132, 1961: 49); as '*Sphaeria rubiformis* ad truncos *Alni* et *Coryli* Kunze in hb. Persoon' (L 910.269-426); as '*Sphaeria rubiformis* Chaillet in hb. Pers.' (L 910.269-438).

Hypoxylon porphyreum Granmo n. sp.

Stromata in cortice, pulvinata, 0.2-0.8 cm in diam. et 0.2-0.4 cm alta, interdum late effusa, tenuissima, 1-2 × 1 × 0.1 cm, in ligno confluentia, 5-6 × 0.5-3 × 0.2-0.7 cm, colore cineraceo-rubiginoso vel porphyreo vel lilacino-fusco. Perithecia *globosa vel ovoidea, parum vel numquam prominula, 280-420 μm alta, 180-350 μm lata, ostiolo umbilicato.* Asci *p.sp. 55-88 × 6-9.5 μm, stipitibus 40-80 μm. Annulus apicalis in solutione Melzeri dilute coerulescens, discoideus. Ascosporae (9-)10-13.5(15) × 4-5.5 μm, in medio 11.4 × 4.8 μm, ellipsoideo-inaequilaterales, fuscae; perisporium in KOH dehiscens, rima germinativa latere convexo manifesta, undulata vel plus minusve recta. In 10% solutione KOH fragmenta stromatis viridicantia fusca. - Holotypus: AG 187/74 (BG 3) (v.i.).*

Figs 23 A-C, 25 (map), 31 (stroma), 41, 48; 54 (SEM).

Description. *Stromata* 0.2-0.8 cm in diameter, mostly 0.4-0.5 cm and 0.2-0.4 cm thick, usually pulvinate on bark, but sometimes thin and effused, on wood coalescing to 5-6 × 0.5-3 × 0.2-0.7 cm, mostly lacking perithecial contours. Young and mature stromata (greyish) red brown (9E6), greyish red (11D5) to grey magenta (12D6-13D6) or violet brown (10E5,E6; 11E5,E6), on ageing dark brown. Stromata normally covered with a grey or greyish yellow pruina of conidiophores and conidia, ca. 75 μm thick. *Ectostroma* without pruina ca. 125 μm, consisting of an outer 25μm thick reddish brown layer covering an orange layer, 50-100 μm. *Entostroma* basal part 1-3 mm, grey-brown with reddish tone, firm, in pulvinate stromata with a whitish centre, tissue consisting of spherical, thick-walled cells 4-12 μm in diam. *Perithecia* globose or ovoid, 280-420 μm high, 180-350 μm broad, wall 25-30 μm, immersed, uniseriate. Ostioles umbilicate. *Asci* p.sp. 55-88 × 6-9.5 μm, m. 74 × 8.1 μm, st. 40-80 μm, m. 66 μm, amyloid with a reduced discoid annulus, 3 × 0.5 μm. *Paraphyses* exceeding the asci, 2-3 μm broad, septate, sparsely branched. *Ascospores* (9-)10-13.5 × 4-5 μm, m. 11.4 × 4.8 μm (n=390/11), inequilaterally ellipsoid, transversally striate (SEM), brown (6D7-E7), with a 0.5 μm thick dehiscent perispore with a tiny evagination towards one end, usually visible on the more convex side only. Germ slit distinct, full length on convex side of the spore, straight or somewhat undulating. *Pigments* in 10% KOH: Fragments of outer part of stroma brown with a greenish tone (4E8).

Culture. Inoculation from 3 week old sterile culture on PDA onto 2% MA for 20 days (alternating day and night at ca. 21 °C) 7.5 cm in diam., with 5-6 concentric, alternating whitish and brownish red zones. Whitish zones with ca. 2 mm high tomentum. Centre reddish brown, 2-2.5 cm in diam. Reverse red brown in centre, paler red towards margin. Conidiophores mononematous, to 500 μm high, or towards the centre forming 12-15 μm broad, brown synnemata, consisting of about six intertwining hyphae. Conidiogenous structure *Virgariella*-like, leading axis yellowish brown, 4 μm broad, coarsely rough in some cells of the conidiogenous region. Conidiogenous cells (1-)2 on each terminus, 15-30 μm long, hyaline, smooth. Conidia 4-5.2 × 2-2.5 μm, hyaline, ovoid.

Taxonomic notes. *Hypoxylon porphyreum* was included in *H. fuscum* by Granmo et al. (1989). However, besides other characters, the pigments of these species are different. This was demonstrated by thin layer chromatography by Granmo (1977), and confirmed recently by using high performance liquid chromatography (A. Granmo, unpubl. data). The latter experiment also demonstrated that bark extracts and wood extracts of the hosts of *H. porphyreum* (*Quercus*) and *H. fuscum* (*Corylus*) had absorption spectra different to that of the stromatal extracts, and thus did not have any direct influence on the stromatal pigments. Furthermore, a phylogenetic study

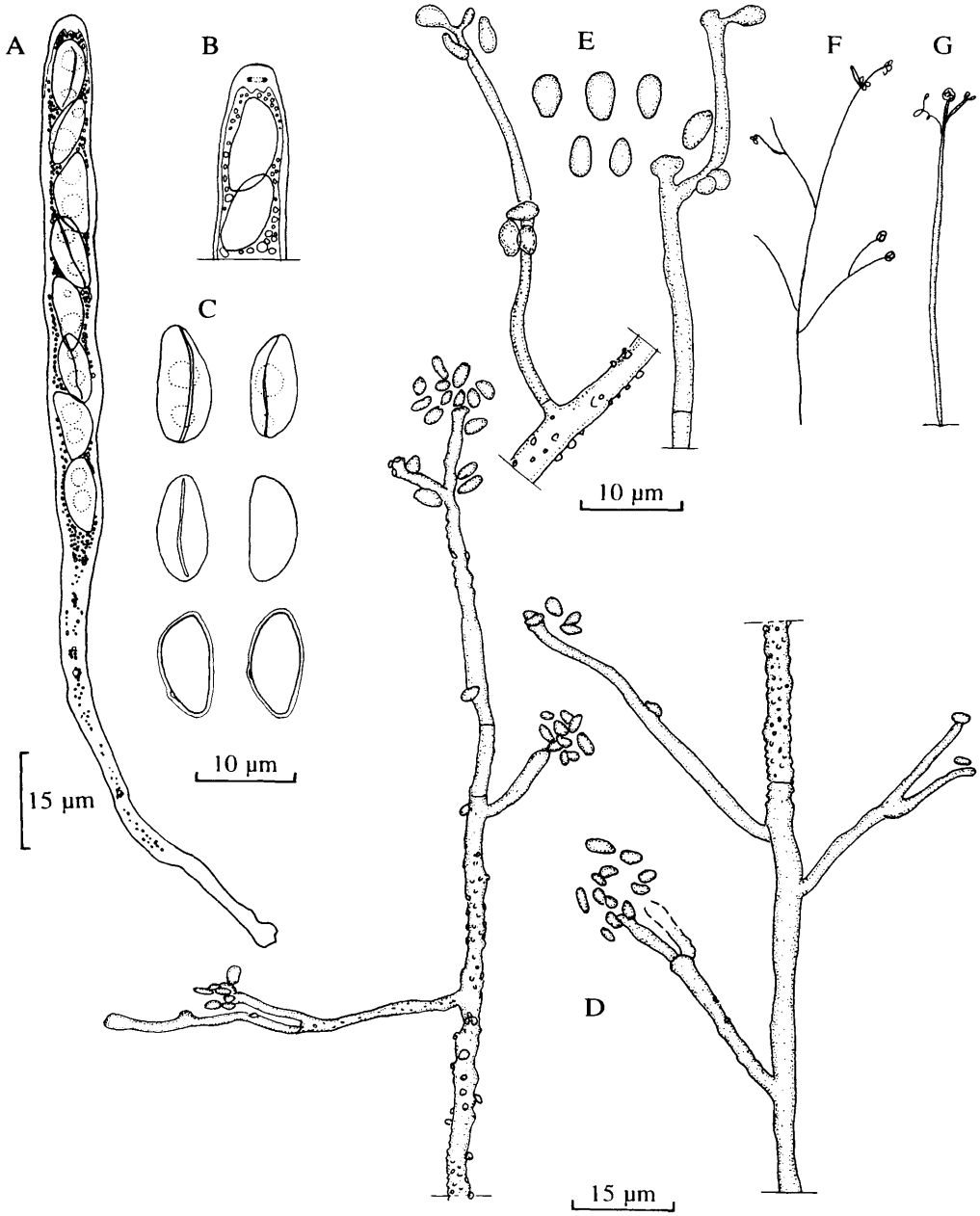
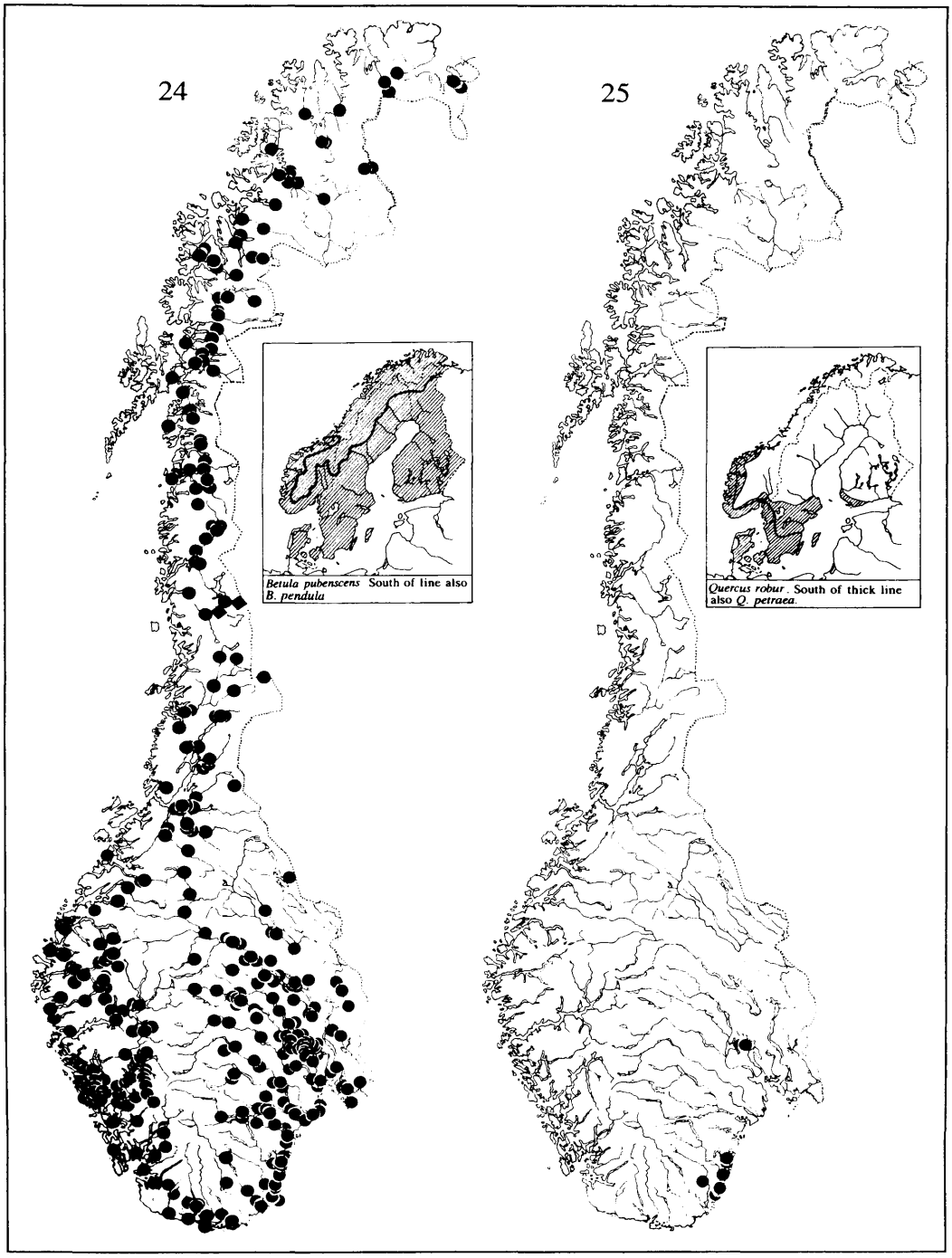


Fig. 23. *Hypoxylon porphyreum* n. sp. A. Ascus. B. Ascus apex in MZ. C. Ascospores. The perispore with a tiny evagination is indicated in the two lowermost spores. A, B and uppermost two spores from holotype (BG 3), the remaining four spores from TROM 304. D-G. Anamorph in culture. D. Conidiophore, terminal (left) and basal parts. E. Branches with terminal, conidiogenous cell and conidia. F. Habit of mononematous conidiophore. G. Habit of synnematous conidiophore. F-G not drawn to scale.



Figs 24-25. Distribution in Norway. Fig. 24. *Hypoxylon multiforme* and the Nordic distribution of its most common host. Fig. 25. *Hypoxylon porphyreum* and the Nordic distribution of its host.

on *Nemania* based on molecular data (Granmo et al. 1999) demonstrated that *H. porphyreum* is a species on its own, separate from *H. fuscum*. The small thickening in the perispore, reliably observed only in water mounts, is remarkable because it is typical of sect. *Annulata*-species (Ju & Rogers 1996).

Ecology. *Hypoxylon porphyreum* occurs on the outer parts of dead and dry, mostly corticated branches of *Quercus robur*, and twigs of young, dead but still rooted trees. It probably occurs on *Q. petraea* as well, although not recorded on this host with certainty.

Distribution. *Norway.* Ak, Oslo, AA. *Hypoxylon porphyreum* has been recorded in the nemoral and boreonemoral regions of southeastern Norway. Even though oaks are scattered over the whole of western Norway, there are no collections from that region, which has been well examined with regard to *Hypoxylon. Total.* Known also from Sweden, and probably recorded as *H. fuscum* on *Quercus* from many countries.

Differentiation. *Hypoxylon porphyreum* differs from *H. fuscum* in larger, more irregular pulvinate stromata with different colours and a more luxurious pruina or anamorph. It has somewhat smaller spores than *H. fuscum*, and a reduced annulus. Until now it has only been found on *Quercus*.

Comments. The species has earlier been reported from Norway by Granmo (1977) and by Hungnes (1982) (as *H. porphyreum*, not validly publ.).

Specimens examined. Norway: Ak: Bærum: Bjerke Oct 1825 *Quercus robur*(bw) *Sphaeria fusca* Fr. S.C. Sommerfelt (O 10). - Oslo: Tøyen 1840 *Quercus*(bw) (O 12), 1840 *Quercus*(b) N.G. Moe (O 11). - AA: Arendal: Fløystad near Arendal Oct 1972 *Quercus*(b) S. Fløystad (BG 13). Birkenes: Birkeland 20 Jul 1974 *Quercus*(b) AG 117/74, 119/74 (BG 8,9). Grimstad: Einarfjell 2 km NW Reddal16 Jul 1995 *Quercus*(w) AG 131/95, 132/95, 133/95 (TROM 303,304,305). Lillesand: Beintjørn 9 Jun 1975 *Quercus*(b) A.-E. Torkelsen 175/75, 161/75 (O 273,278). Lillesand 7 Jun 1981 *Quercus*(b) G. Hungnes (O 264). Flørenes 2 Aug 1981 *Quercus*(b) G. Hungnes (O 261). Risør: Jostadvatn at E18 3 km S of Holt 23 Jul 1974 *Quercus*(b) AG 187/74 HOLOTYPUS (BG 3, ISOTYPI in O, UPS), AG 191/74, 182/74, 181/74(bw), 183/74(bw) (BG 4,5,6,7). 3 km S of Bossvik 19 May 1977 *Quercus*(b) A.-E. Torkelsen 57/77 (O 283). Tvedestrand: Songe 20 May 1977 *Quercus*(b) A.-E. Torkelsen 78/77 (O 274). **Sweden:** Öland: Persnäs parish Stenninge 10 Aug 1952 *Quercus*(b) J.A. Nannfeldt 12446 (UPS). Stenninge S-wards 1 Aug 1953 *Quercus*(bw) J.A. Nannfeldt 13282 (UPS, BG 1).

Hypoxylon rubiginosum (Pers.: Fr.) Fr.

Summa Veg. Scand. 2: 384 (1849) - *Sphaeria rubiginosa* Pers.: Fr., Syst. Myc. 2: 340 (1823); Pers., Usteri's Annln Bot. 20: 121 (no. 126.) (1796), Syn. Meth. Fung.: 11 (1801) - *Sphaeria granulosa* Pers., Syn. Meth. Fung.: 11 (1801) - *Sphaeria multiformis* Fr.: Fr. [var.] β. *granulosa* (Pers.: Fr.) Fr., Syst. Mycol. 2: 334 (1823) - *Hypoxylon botrys* Nitschke, Pyren. Germ.: 34 (1867) - *Hypoxylon fragile* Nitschke, Pyren. Germ.: 39 (1867).

Figs 26 A-D, 32 (stroma), 34 (map), 42; 52 (SEM).

Description. *Stromata* 2-17 × 0.8-6 × 0.06-0.13 cm, effused, with one or more sides attenuated, usually on wood; on bark occasionally irregularly effused-pulvinate. A brownish pruina, 20-30 μm thick, covers the surface of young and mature stromata. Young stromata yellow ochre, then rust brown to (dark) brown (8F8/9F8, 7E7-E8/7F7-F8), soft. Old stromata without pruina, black and brittle. Perithecial elevations distinct, easily visible to the eye. *Ectostroma* without pruina 30-120, mostly 70 μm, waxy, shiny, inside orange to rusty, often extending into the entostroma between the perithecia. *Entostroma* brown with yellowish granules, soft, basal part 100-200(-900) μm, often with a shining basal zone resembling the ectostroma. *Perithecia* 420-600 μm high, 310-550 μm broad, globose or oblong, uniseriate, occasionally 2-3-seriate, wall 30 μm.

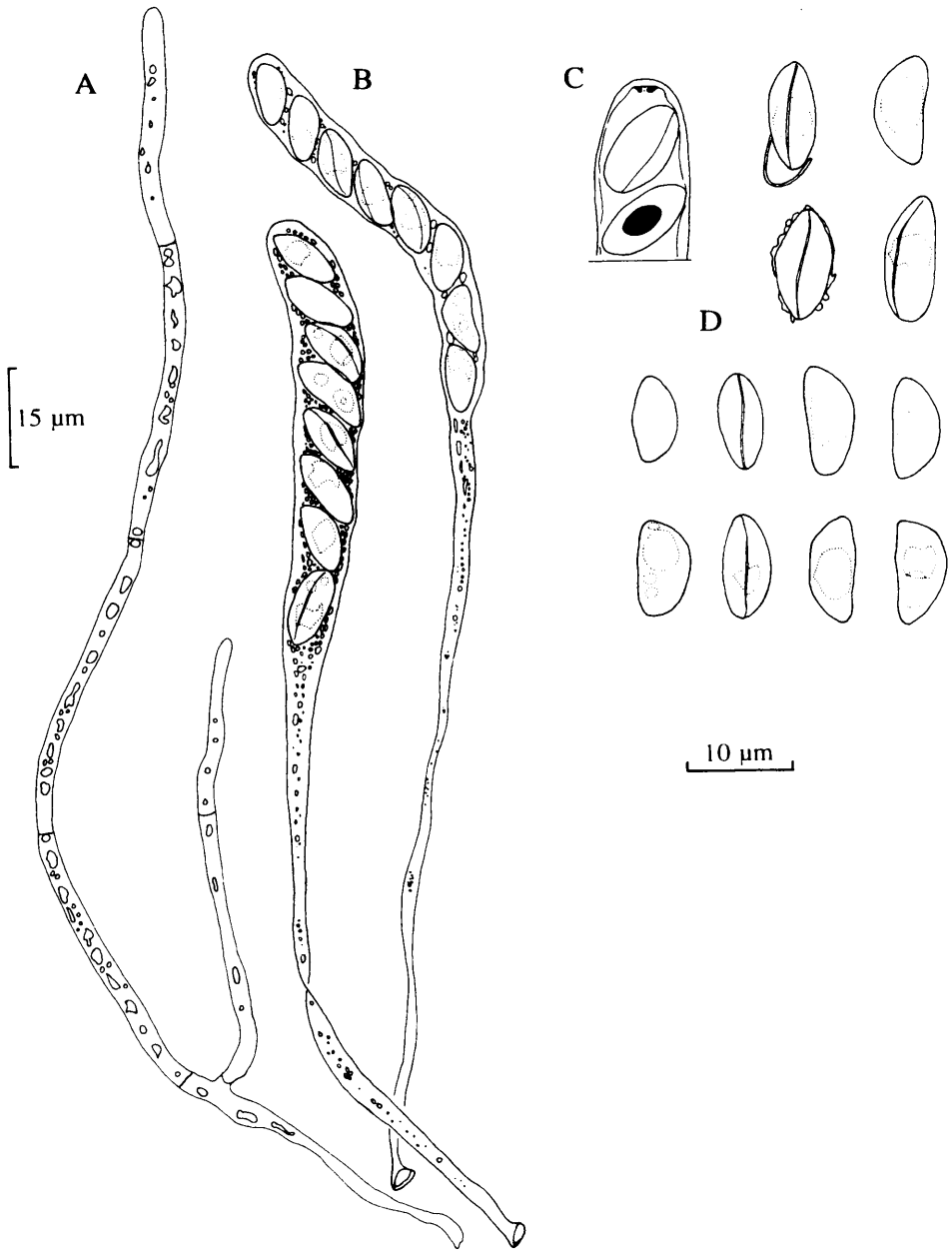
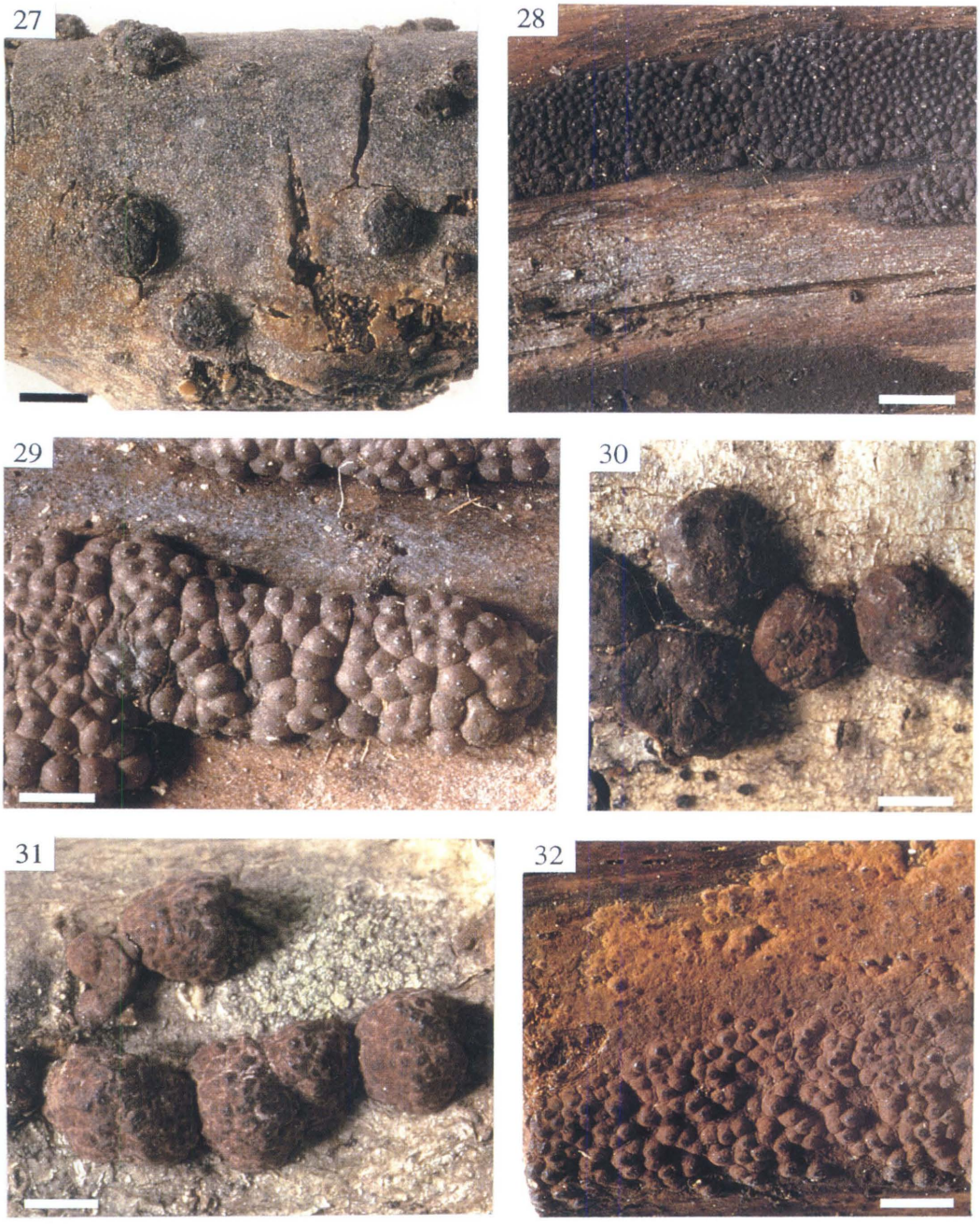


Fig. 26. *Hypoxylon rubiginosum*. A. Paraphysis. B. Asci. C. Ascus apex in MZ. D. Ascospores. The first spore in the uppermost row with still adhering part of perispore, and the first spore in the second row with yellow mucous attachments. From O 14, except for the right ascus which is from O 8.



Figs 27-32. Photographs of stromata. Fig. 27. *Hypoxylon laschii* (O 2). Fig. 28. *H. macrosporum*. Part of an immature stroma at the bottom of the picture (TROM, GM 7511). Fig. 29. *H. multiforme*, effused specimen (TROM 581). Fig. 30. *H. multiforme*, pulvinate specimen (TROM 583). Fig. 31. *H. porphyreum* (O 283). Fig. 32. *H. rubiginosum* (O 69). - Rule: 2 mm.

Outer wall tissue remains brown in water mounts. *Asci* p.sp. (50-)55-85 × 6-9.5 μm, m. 66 × 8 μm, st. 45-88(-115) μm, m. 73 μm, amyloid with discoid annulus 2-3 × 0.7-1 μm. *Paraphyses* to 350 μm long, 2.5-3 μm broad, septate, sparsely branched at base, with yellow guttules. *Ascospores* (8-)9-12.5(-13.5) × (3.5-)4-6 μm, m. 10.3 × 4.7 μm (n=314/14), brown, inequilaterally ellipsoid, transversally striate (SEM), with dehiscent perispore and one central guttule (rarely 2-3). Germ slit faint, straight or slightly undulating, the whole spore-length on the convex side. *Pigments* in 10% KOH: Ectostroma freed from pruina liberates red orange pigment, which gradually turns to yellow orange and then yellow brown to the naked eye. Entostroma yields a pale red colour turning yellowish brown. The yellow and brown granules of the pruina turn pale bluish green (in LM) in KOH.

Taxonomic notes. Several of the nearly 60 synonyms listed by Miller (1961) for *Hypoxylon rubiginosum* have now been attributed to separate species or varieties. Though *H. rubiginosum* has thus become much more homogenous than before, considerable difficulties still exist in distinguishing it with certainty from related taxa, particularly in the tropics and subtropics.

Ecology. *Hypoxylon rubiginosum* is a secondary saprobe recorded on numerous deciduous tree species in Norway (Tab. 2). *Fraxinus* and *Ulmus* are the most important hosts. It is most frequently encountered on decorticated, decaying wood on the ground. Its absence from *Betula*, *Corylus* and *Prunus* is not easily explained.

Distribution. *Norway*. Ak, Oslo, Bu, Ve, Te, AA, VA, Ro, Ho, SF, MR, ST. The northernmost localities in Norway are at about 62.5 °N, at Sunndalsøra (MR). Its distribution in Norway as well as in the rest of Norden is roughly confined to the regions south of the middle boreal. *Total*. Common all over Europe, parts of Asia (Bondarceva 1975, Cherepanov 1993), North America (Ju & Rogers 1996), and northern part of South America (Dennis 1970). The reports from central and southern Africa (Dennis 1963: 324, Martin 1969: 173) may just as well represent related taxa.

Differentiation. *Hypoxylon rubiginosum* may be confused with effused forms of *H. fuscum*, or with *H. cercidicola*, which has a stroma surface lacking perithecial contours, or *H. salicicola* with small spores. Careful examination is usually necessary to distinguish these species.

Comments. Sommerfelt (1826, 1827) reported *Hypoxylon rubiginosum* (as *Sphaeria rubiginosa* on *Alnus*) from Saltdalen (No). This is the small-spored *H. salicicola* on *Salix*. Rostrup (1904) referred to collections from Oslo and Dovre in the Oslo herbarium. Further, it has been treated by Granmo (1977), Hungnes (1982), and Granmo et al. (1989).

Specimens examined. Norway: S.l.d.n.c. *Sorbus aucuparia*(w) *H. rubiginosum* teste C.L. Shear 1923 (O 10), *Populus*(b) (TRH 71, ex herb. O). S.l.d. *Quercus* N.G. Moe (O 5). - Ak: Asker: Hvalstad 5 May 1963 *Fraxinus*(w) I. Egeland, G. Gulden, F.-E. Eckblad (O 3). Hurdal: Hurdalssjøen Brustadkollen 31 Aug 1972 *Alnus*(w) s.n.c. (O 2). - Oslo: Kristiania 1844 *Ulmus*(w) s.n.c. (O 16). Aker Frøn s.d. *Quercus*(w) N.G. Moe (O 7). Mærradalen s.d.n.c. *Populus*(w) (O 15) (Rostrup 1904:19). Ullern s.d.n.c. *Ulmus*(w) (O 14), s.d. *Ulmus*(w) N.G. Moe (O 8), Oct 1840 *Ulmus*(w) N.G. Moe (O 9) (Rostrup 1904:19). - Bu: Lier: Between Lierbyen and Tranby 15 Sep 1974 *Ulmus*(w) I. Røsberg (BG 46). - Ve: Larvik: Jordstøyp in Kvelde 300 m a.s.l. 17 Oct 1995 *Populus tremula*(w) H. Andersen 125-1103 (O 101). Tønsberg: Gullkronen at Jarlsberg estate 12 Oct 1978 *Fraxinus*(w) A.-E. Torkelsen 289/78 (O 67), 1 Oct 1983 *Fagus*(w) S. Aase (O 69). - Te: Bø: Uvdalsheia N-side of Gygrestolen 27 Jul 1974 *Acer*(bw) AG 238a/74 (BG 40, duplicates, ass.with *H. multiforme*), *Acer*(2w) AG 241/74, 242/74 (BG s.n.), *Ulmus* (w) AG 235/74 (BG 44), *Fraxinus*(w) AG 228/74 & O. Vevle (BG 41). Kviteseid: Kviteseid at the river above the main road 26 Jul 1974 *Fraxinus*(w) AG 209/74 (BG 42). Seljord: Seljord above junior highschool 26 jul 1974 *Alnus incana*(w) AG 220b/74 (BG 43). - AA: Birkenes: Birkeland 20 Jul 1974 *Salix*(w) AG 115/74 (BG 37). Grimstad: Søm at Fevik 20 Jul 1974 *Fagus*(w) AG 121/74 (BG 36). - VA: Farsund: Gaupeland, Havnehagen 20 Jul 1995 *Ulmus glabra*(w) AG 167/95 (TROM 93). Lindesnes: Vigeland 17 Jul 1974 *Salix*(w) AG 96/74 (BG 34). - Ho: Granvin: Between Eide and Ystås 24 Mar 1950 *Fraxinus*(w) J. Stordal 3488, 3481 (BG 52, O 70). Folkedal 4 Apr 1950 *Fraxinus*(w) J. Stordal 3573 (O 68). Granvin hillside 200 m E of the outlet of the river 8 Jul 1974

Fraxinus(2w) AG 8/74, 10/74 (BG 22,23), *Sorbus aucuparia*(w) AG 12/74 (BG 24), 200 m N of Eide railway st. 24 Jul 1994 *Sorbus aucuparia*(w) AG 39/94 (TROM 85). Ulvik: Ulvik at the river 200m NW of Ulvik Camping 9 Jul 1974 *Ulmus*(w) AG 15/74 (BG 25). Voss: Mølster 2 Aug 1995 *Fraxinus*(w) AG (TROM 94). - SF: Stryn: Strynsvatn Flostranda nature reserve 20 Jul 1994 *Tilia cordata*(w) AG 8/94 (TROM 87), 21 Jul 1994 *Ulmus*(w), *Tilia cordata*(w) AG 18/94, 15/94 (TROM 73,77). - MR: Sunndal: Sunndalsøra at Driva 15 Jul 1973 *Acer*(w) AG 74/73 (BG 48). - ST: Dovre s.d.n.c. *Salix*(w) (O 6) (Rostrup 1904:19). **Denmark:** Horsens Klokkedalen 15 Sep 1972 *Fagus sylvatica*(w) A.-E. Torkelsen (O 65). **Germany:** Mecklenburg: Werder zu Schwerin Jun 1850 leg. Wüstnei *Salix*(b) *Hypoxylon botrys* (Nitschke 1867:34) (B, ex herb. Nitschke, SYNTYPUS). Westfalen: Nienberge b. Münster Oct 1865 *H. botrys* auf *Quercus* (Nitschke 1867: 34) (B, ex herb. Nitschke, LECTOTYPUS (cf. Gerhardt & Hein 1979; HOLOTYPUS sec. Ju & Rogers 1996). Gasselstiege in der Umgebung v. Münster May 1864 leg. Nitschke *H. fragile* (Nitschke 1867:39) (B, ex herb. Nitschke, LECTOTYPUS (cf. Gerhardt & Hein 1979)). Erdmanns b. Münster Jun 1866 *Salix fragilis*(w), *H. fragile* (Nitschke 1867: 39) (B, ex herb. Nitschke, SYNTYPUS (cf. Gerhardt & Hein 1979)). Nienberge b. Münster Feb 1866 leg. Nitschke *H. purpureum* (Nitschke 1867: 37) (B, ex herb. Nitschke). **Sweden:** Östergötland: Kvillinge parish, Near Dvardala at the creek 28 Oct 1910 *Quercus robur*(w) Erik Haglund (BG 18). **Country unknown:** Ex herb. Persoon as '*Sphaeria granulosa* Syn Fung p. 11? *Sphaeria multiformis* Fries' (L 910.267-362, HOLOTYPUS of *S. granulosa* sec. Ju & Rogers 1996). '*Sphaeria granulosa*? var.?' (L 910.267-365).

Hypoxylon salicicola Granmo n. sp.

Hypoxylon rubiginosum var. *salicicola* Granmo ined. - Anamorph: *Nodulisporium*-like (Ju & Rogers 1996: 179).

Ab Hypoxylo rubiginoso *differt in peritheciis minoribus, 240-430 µm altis, 200-360 µm latis, in medio 367 × 274 µm, et in ascosporis minoribus, fere equilateralibus, (6-)7-10 × 3-4.5 µm, in medio 8.3 × 3.8 µm. Pigmentum ectostromatis in KOH dissolutum pauxillo diversum, rubiginosum vel rufescens tunc luteobrunneum. - Holotypus: AG 220/95 (TROM 96) (v.i.).*

Figs 33 A-D, 35 (map), 43; 47 (stroma), 53 (SEM).

Description. *Stromata* 1-8 × 0.5-5 × 0.06-0.09 cm on wood, effused or in elongated bands, or as small cushions when emerging from bark, 0.2-0.5 cm diam. and 0.6-1 mm thick. Dark stromatic lines penetrate the wood. Surface slightly roughened from the usually conspicuous perithecial elevations, covered with a brownish pruina, 15-30 µm thick, which disappears in old stromata. Mature stromata reddish brown to brown (7F5), later dark brown. *Ectostroma* without pruina 50-60 µm, waxy, shiny; inside of thin sections yellow orange with red particles to the outside. *Entostroma* soft, brown with yellow orange or red orange granules, basal part 100-240 µm, sometimes with a thin, shining basal layer resembling the ectostroma. *Perithecia* 240-430 µm high, 200-360 µm broad, m. 367 × 274 µm, globose to ovoid, irregularly uniseriate. Outer tissue of wall looks pale purplish in water mounts. Ostioles umbilicate. *Asci* p.sp. 54-70 × 6-7 µm, m. 64 × 6.5 µm, st. 50-65(-96) µm, m. 56 µm, amyloid with a reduced annulus 2 × 0.5 µm. *Paraphyses* to 260 µm long, 2.5 µm broad, septate, mostly unbranched. *Ascospores* (6-)7-10 × 3-4.5 µm, m. 8.3 × 3.8 µm (n=153/7), slightly inequilaterally ellipsoid, brown (6D6/E6), transversally striate (SEM), with 2 guttules and dehiscent perispore. Germ slit entire length of spore, straight. *Pigments* in 10% KOH: Ectostroma without pruina immediately liberates a brownish red (9C8) pigment, soon surrounded by a yellow zone; after 3-4 minutes becoming yellowish brown viewed with the naked eye. The yellow and brown granules of the pruina turn bluish green (LM) in KOH.

Taxonomic notes. *Hypoxylon salicicola* has hitherto been included in *H. rubiginosum*. However, Ju & Rogers (1996: 179) indicated its status as a separate taxon. They cultured it on

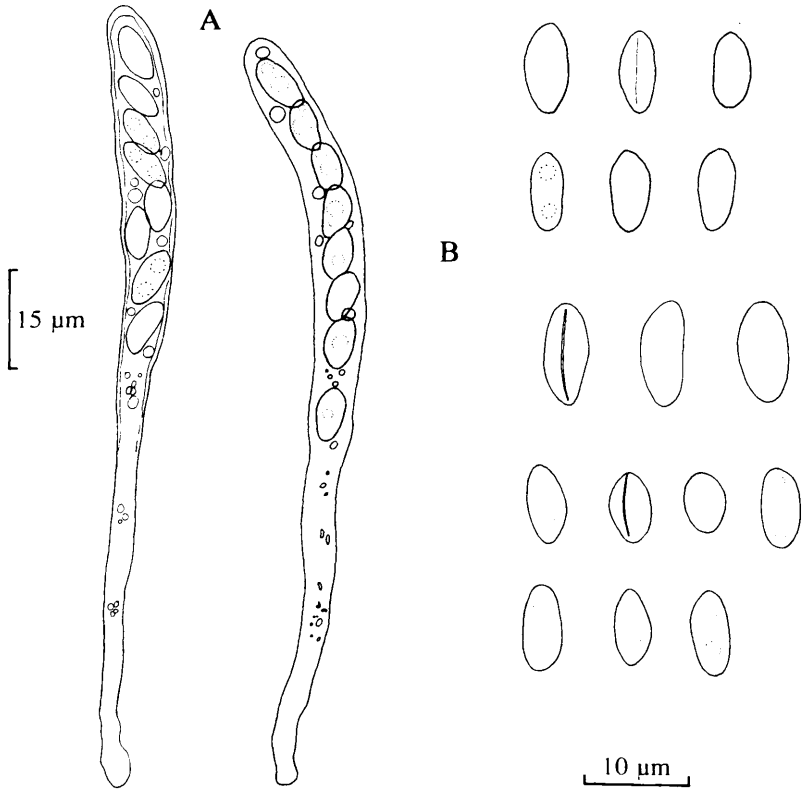
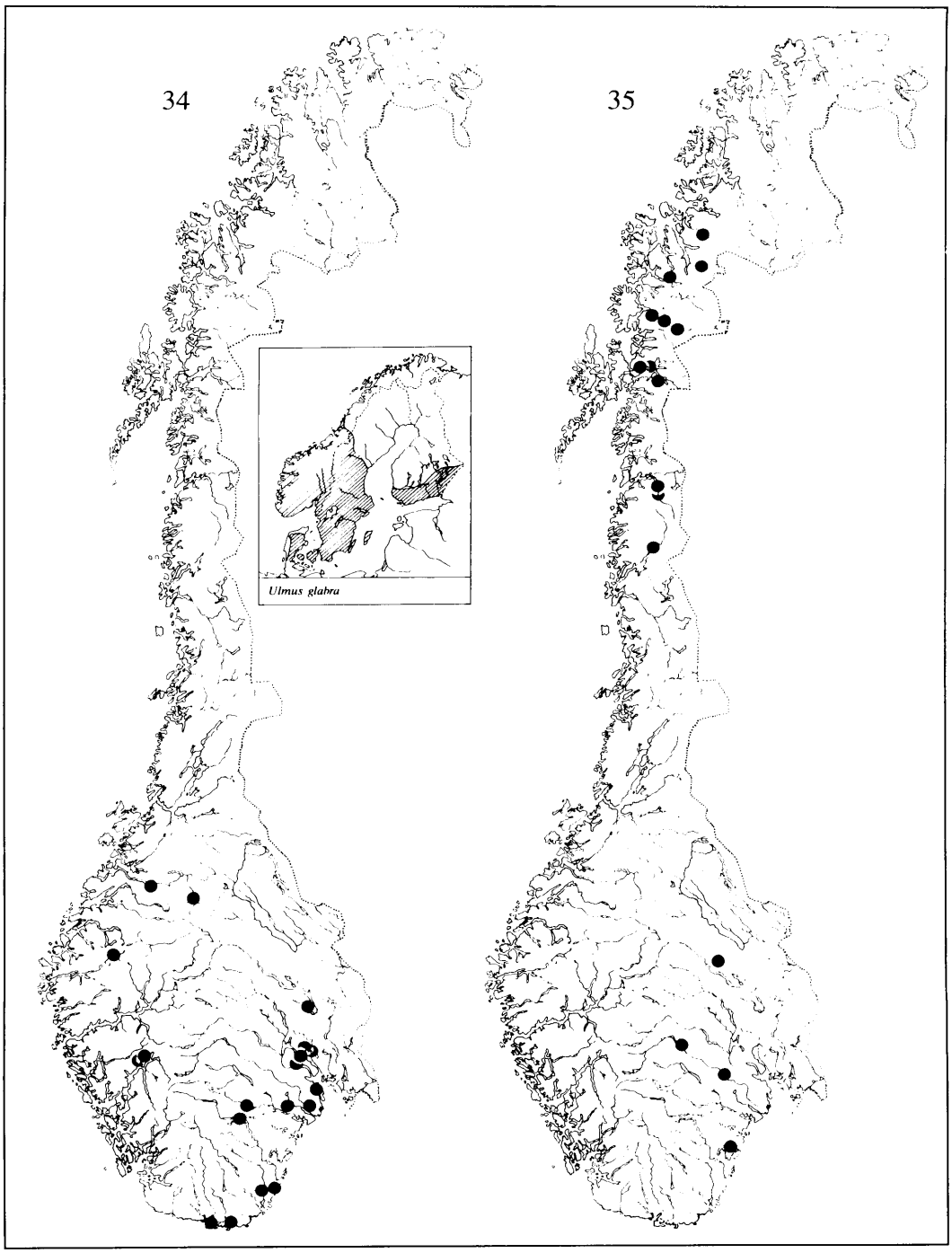


Fig. 33. *Hypoxylon salicicola* n. sp. A. Asci. B. Ascospores. The left ascus and the spores in the two upper rows from holotype (TROM 96), the right ascus and the spores in the three lowermost rows from BG 51.

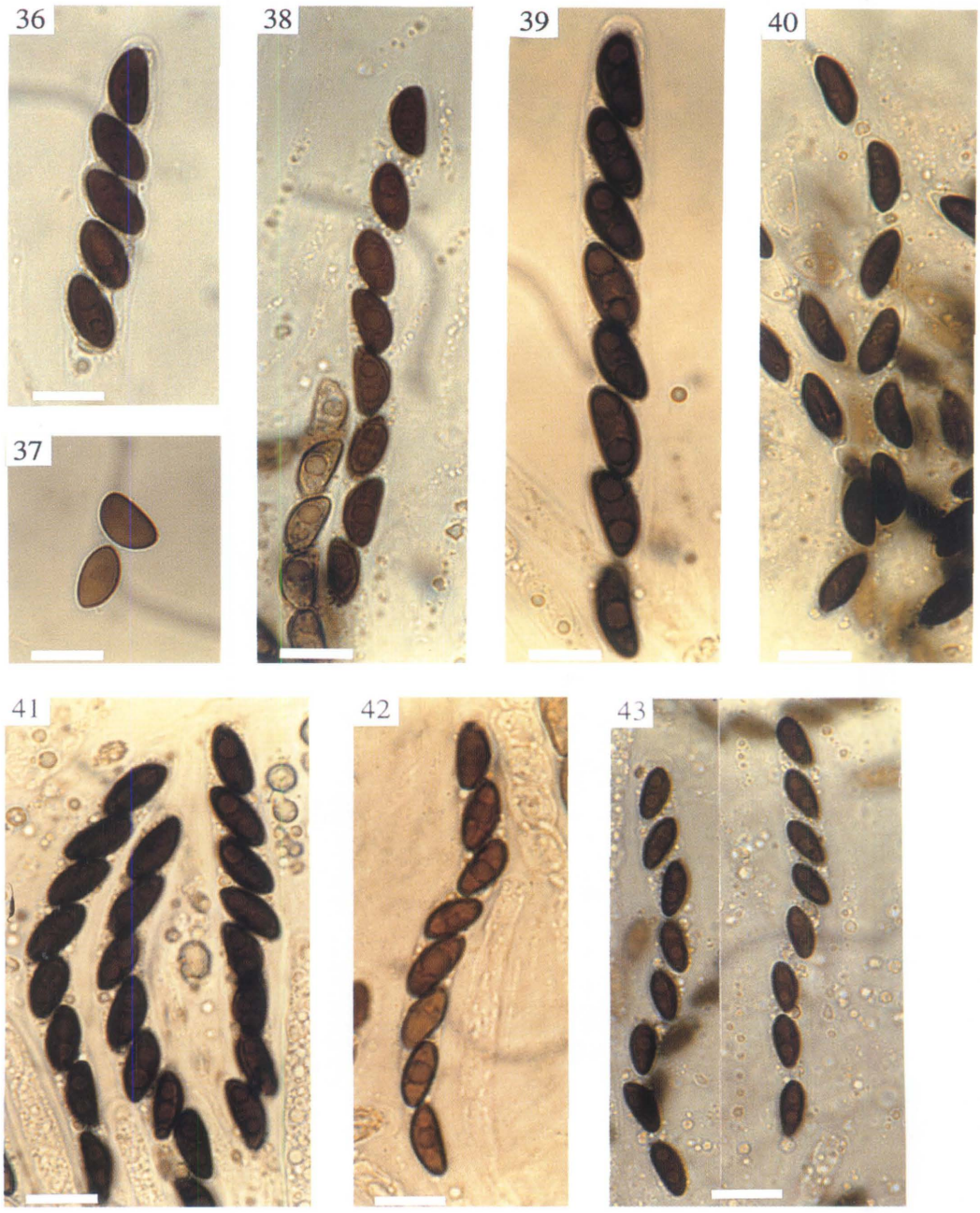
oat agar and found it to be slightly different from *H. rubiginosum* both in anamorph and in cultural appearance. A duplicate specimen of the cultured material (TL-2447) was said to be in Kew, but I did not succeed in tracing it. The report of *Hypoxylon rutilum* L. R. Tul. & C. Tul. on corticated *Salix caprea* from Sweden by Granmo et al. (1989) is not this species, but refers to a specimen of *H. salicicola* with an unusually rich amount of red orange granules in the entostroma. The African-Australian *H. rubiginosum* var. *microsporum* Whalley (1981) is another species with ascospores of size equal to *H. salicicola*, but with different pigments according to Ju & Rogers (1996).

Ecology. *Hypoxylon salicicola* is recorded on dry, decorticated and corticated branches and trunks of dead *Salix* spp. It has recently been found once on corticated branches of *Prunus padus* in Troms. Stromata occur on fairly fresh as well as on rotten wood. In North Norway it is sometimes accompanied by *H. macrosporum*.

Distribution. *Norway*. He, Bu, AA, No, Tr. Common in North Norway where it now is recorded north to Nordreisa (Tr). *Total*. Norway, Sweden. It is also once found on *Salix* in Ari-



Figs 34-35. Distribution in Norway. Fig. 34. *Hypoxylon rubiginosum* and the Nordic distribution of its most common host. Fig. 35. *Hypoxylon salicicola*.



Figs 36-43. Photographs of asci and ascospores. Fig. 36. *Hypoxylon cercidicola* (BG 1). Fig. 37. *H. howeianum* (BG 6). Fig. 38. *H. cohaerens*. Note small thickening in the perispore of the apical spore (TROM 20). Fig. 39. *H. fuscum* (TROM 294). Fig. 40. *H. laschii* (O 2). Fig. 41. *H. porphyreum* (TROM 304). Fig. 42. *H. rubiginosum* (O 69). Fig. 43. *H. salicicola* (TROM, holotype). - Rule: 10 μm.zona, U.S.A. (Ju & Rogers 1996: 179).

zona, U.S.A. (Ju & Rogers 1996: 179).

Differentiation. *Hypoxylon salicicola* differs from *H. rubiginosum* in its smaller perithecia, asci and spores, and slightly different pigments. I do not know if the purplish colour of the perithecial wall is characteristic or just due to observations in fresher specimens than was possible for *H. rubiginosum*.

Specimens examined. Norway: He: Ringsaker: Mesnali chapel 1 Jul 1972 *Salix*(bw) F.-E. Eckblad (O 64). - Bu: Kongsberg: Stengelsrud 3 km N of Kongsberg 16 Sep 1974 *Salix*(w) AG (BG 45). Nore og Uvdal: Rødberg 16 Sep 1974 *Salix*(w) E. Fremstad (BG 47). - AA: Risør: Jostadvatn at road E18 3 km S of Holt 23 Jul 1974 *Salix*(w) AG 180/74, 189/74 (BG 26,27). - No: Evenes: Forra Brenna 17 May 1974 *Salix*(w) AG (BG 50). Forra Hoggvik 18 Sep 1995 *Salix*(w) AG 236/95 (TROM 98). Narvik: Veggelandet Finnvik 18 May 1974 *Salix*(w) AG (BG 51), 16 Apr 1995 *Salix*(w) AG 22/95 (TROM 88). Skjomen Forsheim 1 Oct 1994 *Salix*(bw) AG 70/94 (TROM 72). Rana: Skugghei Holmen 23 Oct 1994 *Salix*(w) F. Skugghei (TROM 99). Saltdal: Saltdalen Feb 1824 *Salix*(w) S.C. Sommerfelt (O 4) (Sommerfelt 1826: 206, 1827: 44, as *Sphaeria rubiginosa* 'rare, on alder'). Røkland railway st. 23 Jul 1973 *Salix*(w) AG 149/73 (BG 49) - Tr: Balsfjord: NW of Laksvatn 18 Jul 1981 *Salix coaetanea*(w) GM 741 (TROM 80). Bardu: Sørdalen Sørmo 15 Jul 1981 *Salix borealis*(bw) GM 601, 615 (TROM 81a,b). Setermoen 16 Sep 1995 *Salix*(w) AG 220/95 HOLOTYPUS, 224/95 (TROM 96,97). Målselv: Rundhaug 3 Oct 1998 *Salix*(w) & *Prunus padus*(b) AG 107/98, 108/98 & I. Mølster, L. Mølster (AG, priv. coll.). Nordreisa: Reisadalen Josvatn-Josdalen 6 Sep 1982 *Salix* (w) GM 1917,1918 (TROM 79a,b). Storfjord: Skibotn 25 Aug 1996 *Salix*(w) AG 27/96 & I. Mølster (TROM 102). Sørreisa: Rabbås 14 Jul 1981 *Salix borealis*(w) GM 582a (TROM 82). **Sweden:** Ångermanland: Örnsköldsvik Arnes 4 Aug 1987 *Salix pentandra*(w) GM 5734 (TROM 84). - Västerbotten: Degerfors: Hällnäs northern slope of the hill NE of hospital 26 Sep 1973 *Salix caprea*(b) O.E. Eriksson (UME 29089) (Granmo et al. 1989 as *H. rutilum*). - Åsele Lappmark: Wilhelmina W of Løvliden 13 Jul 1988 *Salix nigricans*(bw) GM 6311 (TROM 83).

Hypoxylon vogesiacum (Currey) Sacc.

Syll. Fung. 1: 380 (1882) - *Sphaeria vogesiaca* Currey, Trans. Linn. Soc. Lond. 22: 269 (1858). - Anamorph: *Nodulisporium* (Jong & Rogers 1972, L.E. Petrini & Müller 1986).

Figs 44 A-D, 45 (map), 46 (stroma), 57 (SEM).

Description. *Stromata* 0.5-12 × 0.5-6 × 0.1-0.15 cm, in oblong patches or elliptical spots on bare wood, well defined with slightly convex sides. Young and mature stromata brown with a light red tinge, dark magenta (13F4, F5) or purple grey (13F3), older stromata purplish red brown (12F5), finally dark purple. Young stromata are more or less covered by a light grey or yellowish white, compact pruina, which is later replaced by a brown pruina, which may include short conidiophores and conidia. The wood under the stromata shows pronounced dark zones. *Ectostroma* without pruina 60-80 µm, firm, inside red (LM). *Entostroma* soft, basal part 50-200 µm, brown or red brown. *Perithecia* 350-600 µm high, 350-560 µm broad, wall 30-50 µm, globose or ovoid, uniseriate, with insignificant elevations, or more prominent elevations at the stromatal margins. Ostioles umbilicate, sometimes papillate. *Asci* p.sp. 110-167(-178) × 9.5-17 µm, m. 140 × 14 µm, st. (30-)40-80(-115) µm, m. 59 µm, amyloid with discoid annulus, 4-5 × 1.5-2 µm; not infrequently with only 7 obliquely uniseriate spores. *Paraphyses* 280-320 µm long, 1.5-3.5 µm broad, septate, somewhat branched, with yellow guttules. *Ascospores* (16-)17-28(-31.5) × 7.5-12(-13.5) µm, m. 22.3 × 9.7 µm, ellipsoid to inequilaterally ellipsoid, brown (8D7/E7), with several guttules and a 0.3 µm thick, dehiscent perispore in KOH-solution, but largely indehiscent in water. Spore wall appears finely dotted in LM. Perispore smooth, while epispore appears finely foveate (SEM). Germ slit straight or undulating, entire length of spore on most convex side.

Taxonomic notes. Currey (1858) was the first to give a valid description of *Hypoxylon vo-*

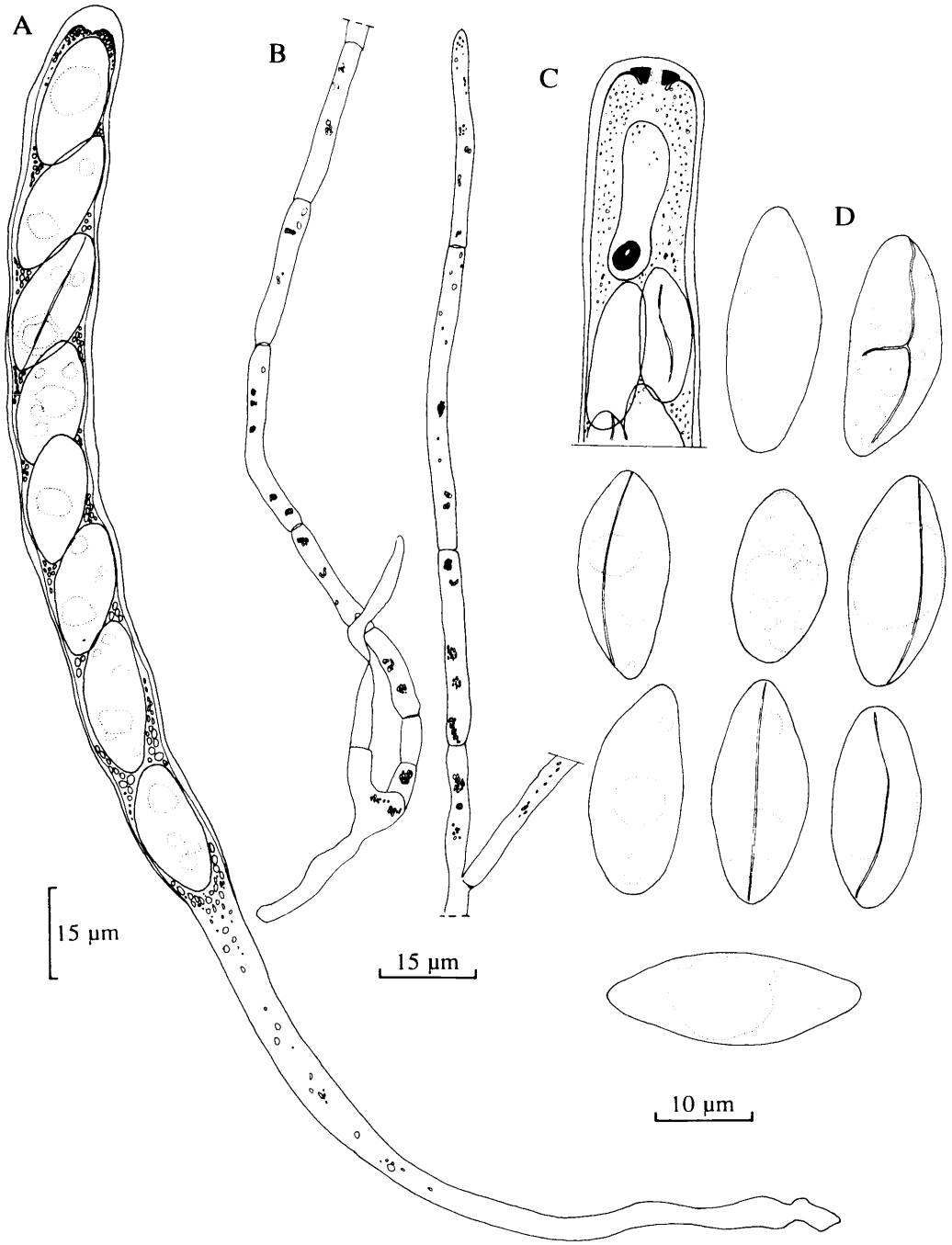


Fig. 44. *Hypoxylon vogesiacum*. A. Ascus. B. Paraphysis. C. Ascus apex of young ascus in MZ. D. Ascospores. A-B from O 7, C-D from O 6.

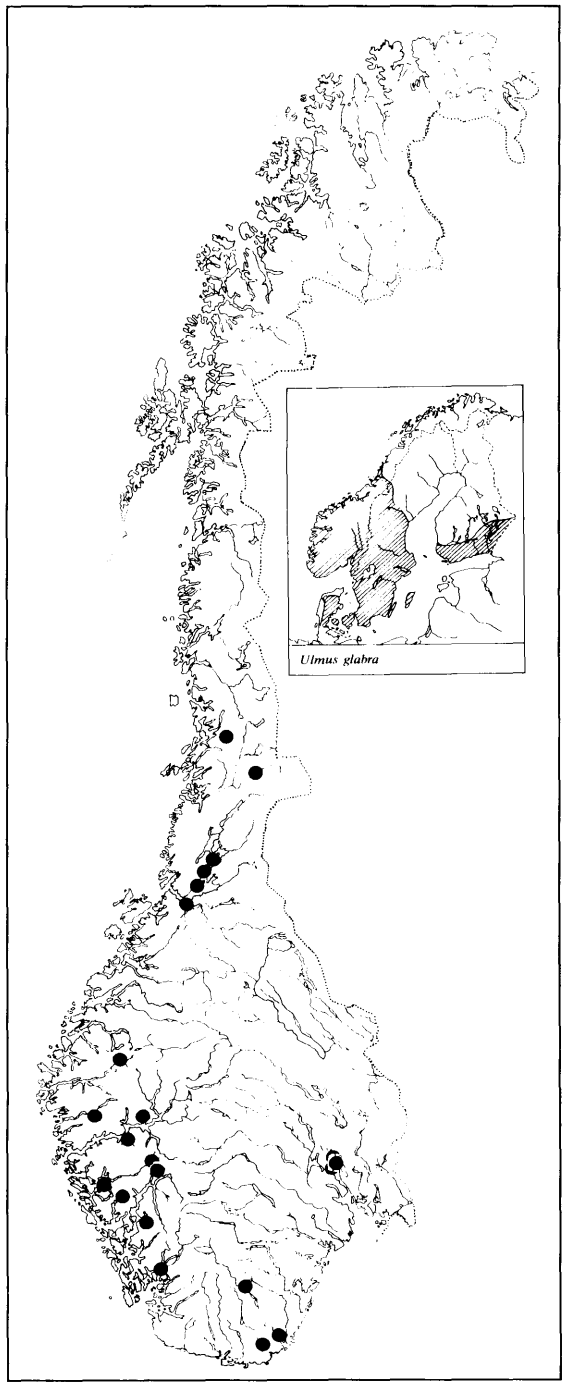
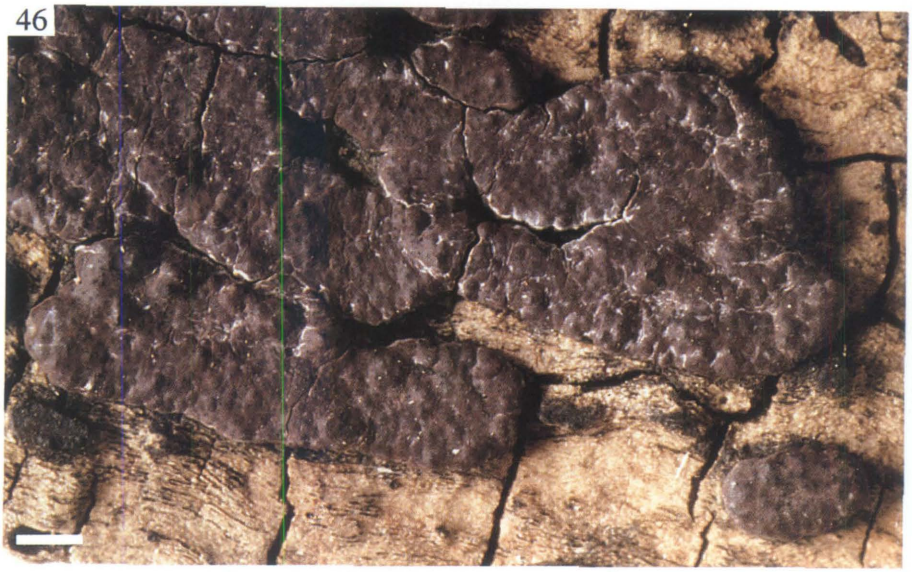
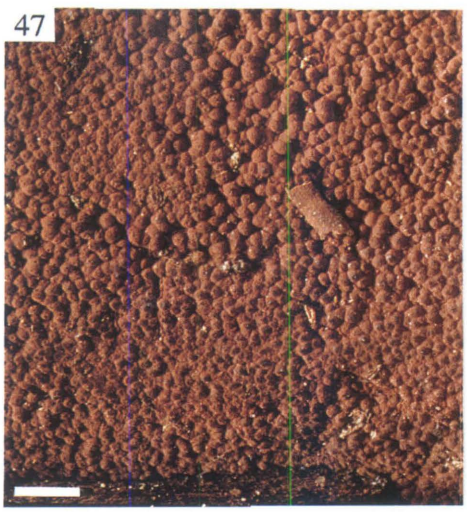
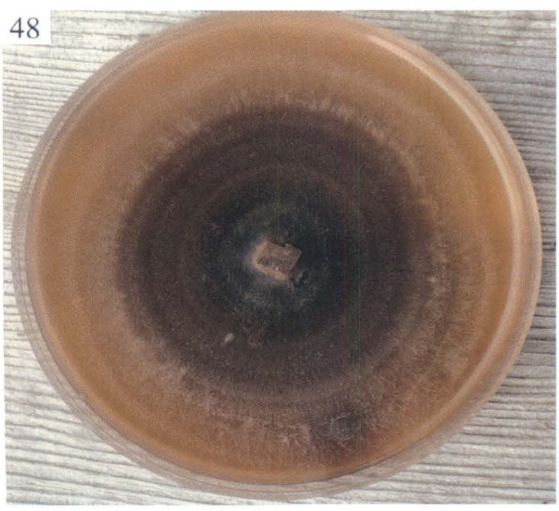


Fig. 45. Distribution in Norway. *Hypoxylon vogesiacum* and the Nordic distribution of its primary host.

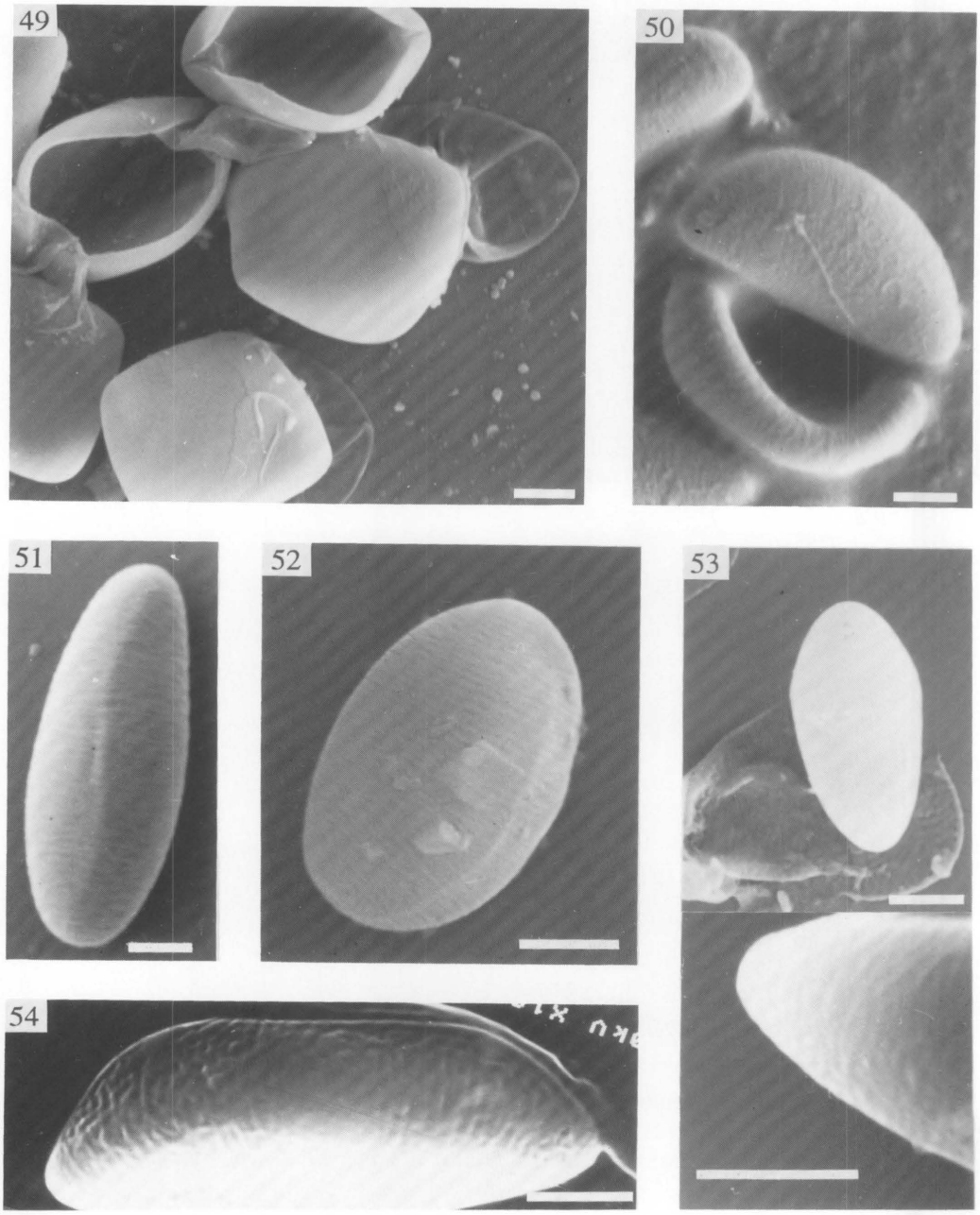




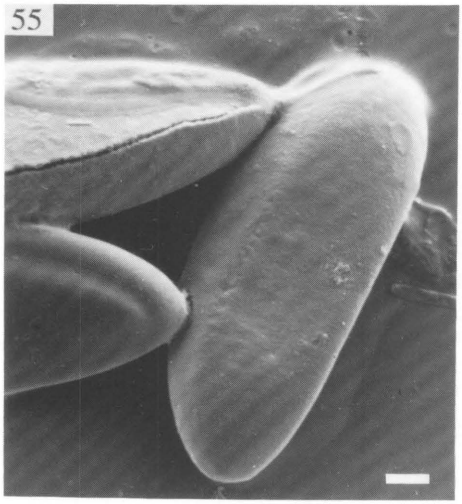


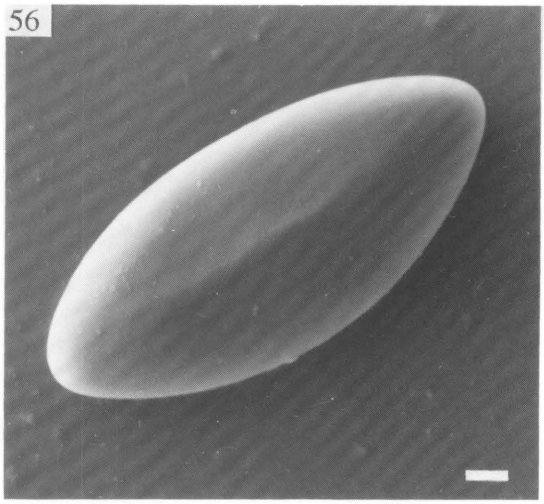
Figs 46-48. Photographs of stromata and culture. Figs 46-47. Photographs of stromata. Fig. 46. *Hypoxylon vogesiacum* (TROM 30). Fig. 47. *H. salicicola* (TROM, holotype). - Rule: 2 mm. - Fig. 48. *Hypoxylon porphyreum*. Culture on 2% MA for 4 weeks at ca. 21 °C (TROM 304).

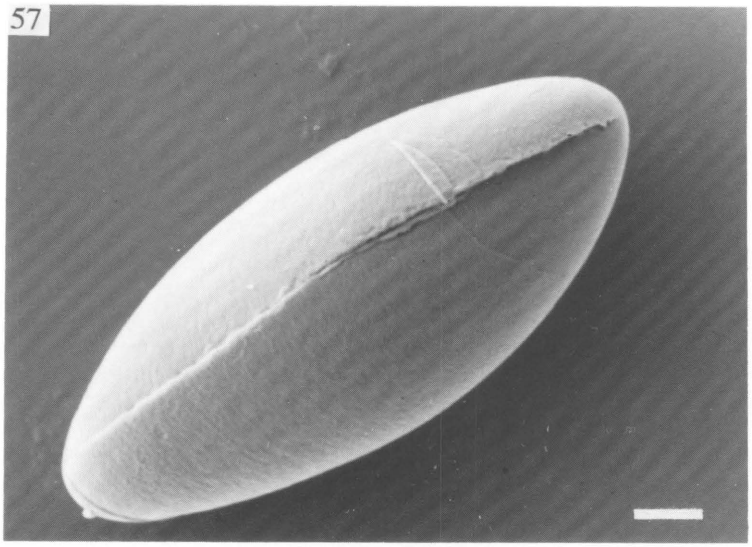
gesiacum based on a specimen in W.J. Hooker's herbarium (K), which has the following note attached: '*Sphaeria vogesiaca* Pers. in Litt. *Ad truncos emortuos Aceris pseudoplatani; affinis Sphaeriae serpentis sed distincta. Mougeot.*', which is almost exactly as cited by Currey (1858: 269). The ascospores of that specimen are 17-26 × 9.5-12 (-13.3) μm, m. 22 × 11 μm (Currey, 1858: '0.0007-0.0008 inch long' (ca. 18-20 μm)). This becomes the holotype and replaces Miller's



Figs 49-54. Ascospores as seen by SEM. Fig. 49. *Hypoxylon multiforme*. The spores have cracked along the germ slit and are releasing the perispore (TROM 597). Fig. 50. *H. fragiforme* (TROM, Lillerød 1965). Fig. 51. *H. fuscum* (TROM 293). Fig. 52. *H. rubiginosum* (O 67). Fig. 53. *H. salicicola*. The upper spore has released its striate perispore (upper spore: UME 29089, lower spore: TROM 72). Fig. 54. *H. porphyreum* (O 278). - Rule: 2 μm.







Figs 55-57. Ascospores as seen by SEM. Fig. 55. *Hypoxylon macrosporum*. Two spores have released the perispore and show faintly verruculose epispore (GM 961). Fig. 56. *H. macrosporum*. Spore with its smooth perispore still attached (TROM 17). Fig. 57. *H. vogesiacum*. Spores with finely foveate epispore (TROM 30). - Rule: 2 μm.

and other authors' supposed 'type': Mougeot & Nestler's Stirp. Crypt. Vog.- Rhen. 765, 1823. The copies of this exsiccata, at least in Leiden, and in Stockholm (Å. Strid, pers. comm.), lack any diagnosis of *Sphaeria vogesiaca* and in no way interfere with Currey's valid publication. Neither is there any description in the index of the exsiccata.

Miller (1961) erected two varieties of this species, var. *microsporum* and var. *macrosporum* (= *H. macrosporum* P. Karst.). I have not seen var. *microsporum*. According to Ju & Rogers (1996: 119) this is *H. fuscopurpureum* (Schwein.: Fr.) M.A. Curtis, a North American species. Nitschke (1867) synonymized *H. vogesiacum* with *H. fuscum* (as did Tulasne & Tulasne (1863)). This can only mean that the species was little known to European mycologists. In fact, it seems to be rare in Europe (cf. L.E. Petrini & Müller 1986, Krieglsteiner & Enderle 1989: 86).

H. vogesiacum was evidently known to Fries from Sweden (Fries 1849: 384, as *H. omphalostoma* n. sp.; cf. Ju & Rogers 1996: 200). Fries' name is, however, a *nomen nudum*.

Ecology. In Norway *Hypoxylon vogesiacum* sporulates on dead, decorticated trunks, branches and stumps of *Ulmus glabra* and *Fraxinus excelsior*. These are also the common hosts in Norden, in addition to the once-recorded hosts *Acer*, *Malus*, *Quercus* and *Tilia* (Granmo et al. 1989). The species is without doubt a strong primary saprobe, which will quickly produce abundant stromata on desiccated wood.

Distribution. *Norway*. Oslo, AA, VA, Ro, Ho, SF, ST, NT, No. *Hypoxylon vogesiacum* is common within its potential distribution area, which is that of *Ulmus*. The northernmost locality is Bindal (No) (65°3'N, 12°40'E). Stands of *Ulmus* further north have not been investigated. *Total*. Sweden, Finland; Central Europe, western North America. Its scarcity or absence in nemoral Europe (for instance Denmark and the British Isles) indicates a slightly eastern distribution.

Differentiation. *Hypoxylon vogesiacum* is an easily recognizable species which differs from *H. rubiginosum* and effused forms of *H. fuscum* by the well delimited, frequently elliptic, purplish stromata with some white pruina, and its much larger ascospores.

Comments. *Hypoxylon vogesiacum* was reported for the first time from Norway and Norden by Granmo (1977), thereafter by Granmo et al. (1989). Rostrup identified a specimen of this fungus in the Oslo herbarium (O) as a variety of *H. fuscum*.

Specimens examined. Norway: S.l.d.n.c. *Ulmus*(w), id. *Ulmus*(w) *H. fuscum* var. det. Rostrup (O 9,3). - Oslo: Kr.ania Bogstadåsen s.d.n.c. *Ulmus glabra*(w) (O 11). Frognerelven near Frøen s.d. *Ulmus*(w) N.G. Moe (O 4). Montebello s.d.n.c. *Ulmus*(w) (O 19). Ullern Oct 1840 *Ulmus*(w) N.G. Moe (O 6), 12 Oct 1879 *Acer*(w) A. Blytt (O 7). Ullernåsen 15 Oct 1922 *Tilia*? O.A. Høeg (O 8). - AA: Bygland: Åraksbø Heddevikji 22 Jul 1974 *Ulmus glabra*(w) & *Pyrus*(w) AG 155/74, 160/74 (BG 13,14). - VA: Kristiansand: Hemmingsvatnet Marktjønn 17 Jul 1995 *Ulmus glabra*(w) AG 137/95 (TROM 32). Mandal: Nomevatnet 18 Jul 1995 *Ulmus glabra*(w) AG 146/95 (TROM 33). Nomevatnet S-end of 18 Jul 1995 *Ulmus glabra*(w) AG 147/95 (TROM 34). - Ro: Suldal: Hylsfjorden Hylen 25 Jul 1994 *Ulmus glabra*(w) AG 55/94 (TROM 31). - Ho: Kvam: Kvamskogen 20 Apr 1974 *Ulmus glabra*(w) O. Balle (BG 5). Kvinnherad: Bondhusdalen E-side of Bondhusvatnet, 29 Jun 1974 *Ulmus glabra*(w) E. Fremstad & E. Fotland (BG 16). Mølster: S-slope of Hanguren 31 Jul 1995 *Fraxinus*(w) AG 211/95 (TROM 42) Osterøy: Vare 30 Jan 1972 *Ulmus glabra*(w) O. Vevle (BG 2). Ulvik: Ulvik at the river 200 m NW of Ulvik Camping 9 Jul 1974, *Ulmus glabra*(w) AG 21/74 (BG 12). - SF: Førde: Mo Kussli 18 Jun 1972 *Ulmus glabra*(w) O. Balle (BG 15). Mo agricultural school May 1973 *Ulmus glabra*(w) O. Balle (BG 1, UPS). Sogndal: Norum hillside NE of the church 22 Jul 1994 *Fraxinus excelsior*(w) AG 35/94, 29 Jul 1995 *Fraxinus excelsior*(w) AG 198/95 (TROM 30, 37). Stedje Skjersnes 29 Jul 1995 *Ulmus glabra*(w) AG 194/95 (TROM 35). Stryn: Strynsvatn Flostranda nature reserve 21 Jul 1994 *Ulmus glabra*(w) AG 21/94 (TROM 29). Vik: Arnafjord 30 Jul 1995 *Ulmus glabra*(w) AG 203/95, 205/95 (TROM 38,40). Arnafjord W-slope of Krokegga 30 Jul 1995 *Ulmus glabra*(w) AG 204/95, 208/95 (TROM 39,41). - ST: Orkdal: Rabberen (= Rapora) 21 Jul 1975 *Ulmus glabra*(w) E. Fremstad (BG 17). - NT: Grong: Sanddøla Mortenslund 13 Jul 1977 *Ulmus glabra*(w) I. Holten & S. Sivertsen (TRH 24). Leksvik: Riakammen 350m alt. 26 Jun 1978 *Ulmus glabra*(w) S. Sivertsen (TRH 26). Aksnes 9 May 1981 *Ulmus glabra*(w) S. Sivertsen (TRH 28). Levanger: Ytterøy Røvik 28 May 1978 *Ulmus glabra*(w) T. Tønsberg (TRH 27). - No: Bindal: Granbostad under Nova 30 Aug 1972 *Ulmus glabra*(w) S. Sivertsen (TRH 25). **Sweden:** Uppland: Almuge parish Harparbol lund 10 Sep 1930 *Ulmus*(w) J.A. Nannfeldt 4111 (UPS), 25 May 1973 *Fraxinus*(w) N. Lundqvist 8398 (UPS). Bandarbo lund 12 May 1973 *Ulmus*(w) Kerstin & L. Holm (UPS). **Country unknown:** Ex herb. Persoon as *Sphaeria serpens* (L 910.265-814, L 910.269-885). Mougeot & Nestler Stirp. Crypt. Vog.-Rhen. 765 (1823): *Sphæria vogesiaca* Pers. in Litt. 'In ligno indurato *Aceris Pseudoplatani* Moug. et Nest. S.' (L 910.250-1678). Herb. W.J. Hooker as '*Sphæria vogesiaca* Pers. in Litt. ad truncos emortuos *Aceris pseudoplatani* affinis *Sph. serpentis*, sed distincta. Mougeot.' (cf. Currey 1858: 269) (K, HOLOTYPUS).

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APPENDIX

APPENDIX 1: ABBREVIATIONS AND SYMBOLS

AG	- A. Granmo (in locality lists)
GM	- G. Mathiassen (in locality lists)
ICBN	- International Code of Botanical Nomenclature (Greuter et al. 1994)
LM	- light microscope/microscopy
m.	- mean (in measurements)
MZ	- Melzer's reagent
p.sp.	- pars sporifera (spore bearing part of ascus)
sec.	- secundum (according to)
s.l.	- sensu lato (in a broad sense); sine loco (without locality)
s.l.d.n.c.	- sine loco, die (et) nomine collectoris (lacking locality, date and collector's name)
st.	- stipes (ascus stipe)
v.i., v.s.	- vide infra (see below), vide supra (see above)
●	- localities of investigated specimens (distribution maps)
◆	- localities according to literature records (distribution maps)

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