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Records of rare aphyllophoroid fungi on Scots pine in northern Sweden

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Wood-inhabiting fungi on *Pinus sylvestris* were examined in three old-growth forests in northern Sweden. A total of 16 rare species of aphyllophoroid fungi are reported. Among the species discussed are *Antrodiella pallasii* and *Skeletocutis kuehneri* which are successors of *Trichaptum* species and previously known from only a few localities in Sweden, and *Byssoporia terrestris* and *Hydnellum gracilipes* which are mycorrhizal species with specific ecological preferences. Three corticioid species from genera *Ceraceomyces* and *Sistotrema* represent possible new taxa.

Keywords: Fennoscandia, fungi, coarse wood debris, red-listed species, *Anomoporia*, *Antrodia*, *Gleophyllum*, *Phlebia*, *Postia*

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Introduction

Over the past decade the old-growth Scots pine (*Pinus sylvestris* L.) forests of northern Fennoscandia have been receiving increasing attention in ecological research, e.g. coarse woody debris (Karjalainen & Kuuluvainen 2002), saproxylic beetles (Sippola et al. 2002) and wood-inhabiting fungi (Junninen et al. 2006). Species inventories have rapidly increased the distributional data of many species groups, especially in eastern Fennoscandia. In northern Sweden, the ecological research on wood-inhabiting fungi in forests dominated by Norway spruce (*Picea abies* (L.) H. Karst.) has been extensive (Bader et al. 1995, Kruys et al. 1999, Edman et al. 2007). The focus on spruce forests has several reasons, especially the established idea that spruce forests host more species than pine forests (Esseen et al. 1997, Rydin et al. 1997). As a consequence, the distributional data of wood-inhabiting fungi in pine forest ecosystems is insufficient. This paper reports recent finds of rare basidiomycetes from three old-growth Scots pine forests in the northern part of Sweden (see Josefsson et al. 2010).

Material and methods

The field work was carried out during two weeks in August 2008 at three different study sites: Eggelats (66˚18'N, 18˚22'E), Vaksamvare (66˚19'N, 17˚27'E), and Tjeggelvas Nature Reserve (66˚37'N, 17˚30'E) located in northern Sweden (Fig. 1). At each study site, we searched for basidiomycetes along transects 20 m wide and 6 km long. Every other pine log encountered with its base inside the transect was examined for both polypores and corticioid fungi. A total of 773 fallen dead pine trees were examined and 1678 records of wood-inhabiting fungi recorded (Josefsson et al. 2010). Specimens collected were dried and later examined in laboratory. The material is preserved in the reference herbarium of Torbjörn Josefsson (T.J.) at the Swedish University of Agricultural Sciences. Some duplicates are placed at the Finnish Museum of Natural History, University of Helsinki

(Finland, H). In addition, some specimens from H and The Komarov Botanical Institute (St. Petersburg, Russia, LE) were studied. Microscopic characters were observed using a Leitz Diaplan microscope and measured at 1000 × magnification, with an oil immersion lens. Stained used were Cotton Blue (CB) and Melzer's reagent (MLZ). A total of 30 spores from each specimen were measured. Fungal names are given according to Hansen & Knudsen (1997) and Niemelä (2005). The species included in the red list of Swedish species (Gärdenfors 2010) are marked with an asterisk (*).

Results and discussion

Anomoporia kamtschatica* (Parmasto) M. Bondartseva

We have four records. This rare and ephemeral polypore was found in Eggelats on relatively moist and moss-covered logs in late stages of decomposition. *A. kamtschatica* produces a slow brown rot. The species is widely distributed in northern parts of Eurasia. It has been found several times in Norway (Ryvarden et al. 2003), Finland, Germany, Czech Republic (Niemelä 1994), France (Pieri & Rivoire 2005), Russia (Parmasto 1963, Bondartseva 1972), Canada, and the U.S.A. (Niemelä 1994). In Sweden, *A. kamtschatica* is rare and reported previously only from a few localities.

Taxonomy of this species is not worked out satisfactorily. Niemelä et al. (2007) showed that the genus *Anomoporia* in old sense is heterogeneous, and proposed a new genus *Anomoloma* Niemelä & K.-H. Larss. for yellow-coloured rhizomorphic species causing a white rot (*Anomoloma albolutescens* (Romell) Niemelä & K.-H. Larss. and its satellites). In turn, *A. kamtschatica* comes close to the generic type of *Anomoporia*, i.e. *A. bombycina* (Fr.) Pouzar, but the degree of their affinity is not yet determined. Some characters of spores (faint amyloid reaction, slightly thickened walls, and subglobose shape) and hyphae (mostly thin-walled, sometimes with oily content), as well as the type of rot, suggest that *A. kamtschatica* may be closely related to the corticioid genus *Amylocorticiellum* Spirin & Zmitr. (Zmitrovich & Spirin 2002), especially its members *A. cremeoisabellinum* (Litsch.) Spirin & Zmitr. and *A. molle* (Fr.) Spirin & Zmitr.

Specimens examined: **SWEDEN. Norrbotten**. Arjeplog, Eggelats, on *P. sylvestris*, 27.VIII and 1.IX.2008 (T.J., H). **RUSSIA. Kamchatka.** Kozyrevsk, on *Larix gmelinii var. japonica,* 21.VIII.1960 *Parmasto* (LE ex TAA 12350, isotype).

Antrodia primaeva* Renvall & Niemelä

We have two records. The species was collected in Tjeggelvas Nature Reserve on dry, large and hard logs. It was described from Finnish Lapland (Renvall & Niemelä 1992), and is now also known from several localities in Norway (Renvall & Niemelä 1992), Russia (Niemelä et al. 2001, Spirin et al. 2006), and China (Dai 2000). In Sweden, *A. primaeva* is very rare (Gärdenfors 2010). Its substrate is mainly pine, often *kelo* -trees (Niemelä et al. 2002), and very rarely Norway spruce. Taxonomy of this species was discussed by Spirin et al. (2006).

Specimens examined: SWEDEN. Norrbotten. Arjeplog, Tjeggelvas, on *P. sylvestris*, 29 – 30.VIII.2008 (T.J., H). **FINLAND. Sompion Lappi.** Savukoski, on *P. sylvestris*, 19.IX.1988 *Renvall & Renvall 1372* (H, holotype).

Antrodiella pallasii* Renvall, Johannesson & Stenlid – Figs 2, 3

Basidiocarp annual, resupinate or effused-reflexed, with small fingernail-like pilei up to 2 mm thick, leathery, cream-coloured. Pores small, 8–10 per mm. *Hyphal structure* dimitic in context; skeletal hyphae sparse in tube trama, 2.5–3 µm wide, faintly cyanophilous (bluish in CB). Dissepiment edges almost monomitic, hyphae somewhat inflated. *Spores* small, broadly ellipsoid, (2.7–)2.8–3.6(–3.8) × 1.7–2.1(–2.2) µm (n = 30), mostly with a central oil drop.

This species was found once in Tjeggelvas Nature Reserve. It has been recorded a few times in Sweden (Johannesson et al. 2000, Edman et al. 2007) and it seems to be very rare and its distribution strongly continental. *A. pallasii* is also known from northern parts of Norway and Finland (Ryvarden et al. 2003) and from the taiga zone of Russia (Niemelä et al. 2001, Kotiranta et al. 2005) and from China (Dai 2000). *A. pallasii* was collected on a hard and thin, moss-covered pine log with dead *Trichaptum abietinum* (P. Karst.) Ryvarden fruitbodies. Johannesson et al. (2000) and Miettinen et al. (2006) describe this species as a clear successor of *Trichaptum* species, inhabiting both spruce and pine.

Specimens examined: **SWEDEN. Norrbotten.** Arjeplog, Tjeggelvas, on *P. sylvestris* with *T. abietinum*, 30.VIII.2008 (T.J., H). **FINLAND. Sompion Lappi.** Savukoski, on *P. abies* decayed by *T. abietinum*, 25.VIII.1992 *Renvall 2990* (H, isotype).

Byssoporia terrestris (DC.: Fr.) M.J. Larsen & Zak

We have four records. *B. terrestris* is a mycorrhizal species inhabiting various kinds of woody debris throughout the boreal zone of Eurasia (Ryvarden & Gilbertson 1993). It is rare but regularly collected in Fennoscandia (Niemelä 2005, Kotiranta et al. 2009). Recent molecular studies revealed the surprising relationships of *Byssoporia*. It is closely related to *Albatrellus,* a genus of stipitate polypores (Larsson 2007). Despite the fact that *Byssoporia* and *Albatrellus* are quite dissimilar in their gross morphology, they share some principal characters, e.g. slightly thick-walled, subglobose spores, thin-walled, mostly clampless hyphae, and mycorrhizal habit.

Specimens examined(all on P. sylvestris): **SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, 23.VIII.2008 (T.J.); Tjeggelvas, 28–30.VIII.2008 (T.J.); Eggelats, 1.IX.2008 (T.J., H).

Ceraceomyces *sp.* – Fig. 4

Basidiocarp thin, pellicular, resupinate; margin cream-coloured, hymenophore smooth, deep creamy to pale brownish, in some places cracking with small fissures. *Hyphal system* monomitic; all hyphae thin-walled, clamped, subicular hyphae clearly wider than subhymenial ones (4–6 µm *vs.* 1.5–2.5 µm). *Cystidia* none. *Basidia* clavate, four-spored, 20–25 × 5.5–6.5 µm, content with numerous oily droplets. *Spores* thin-walled, broadly ellipsoid, (4.7–)5.0–6.4(–7.0) × (3.0–)3.1–4.1(–4.2) µm, negative in MLZ and CB.

This species was found once in Vaksamvare, on a charred pine log. We were unable to find a name for this taxon. Probably it represents a still unnamed species. It seems to belong to the genus *Ceraceomyces* in strict sense because it is quite similar to the core species of this genus, i.e. *C. tessulatus* (Cooke) Jülich, *C. eludens* K.-H. Larss., and *C. microsporus* K.-H. Larss. However, the spore size does not fit any species in this group. Further studies are needed to confirm the differences of this taxon to *C. tessulatus*, which seems to be its closest relative.

***Specimen examined*: SWEDEN**. **Norrbotten.** Arjeplog, Vaksamvare, on charred log of *P. sylvestris*, 24.VIII.2008 (T.J., H).

Gloeophyllum protractum* (Fr.) Imazeki

We have seven records. The species was recorded at all three study sites, inhabiting hard-surfaced pine logs with resin-rich heartwood, lying in open locations, i.e. a typical *kelo* -species (see Renvall et al. 1991, Niemelä et al. 2002). *G. protractum* is a pioneer species inhabiting recently fallen logs and causes intensive brown rot. It occurs in continental parts of Fennoscandia and is widespread in Siberia and North America (Ryvarden & Gilbertson 1993).

Selected specimens studied: **SWEDEN. Norrbotten.** Arjeplog, Eggelats, 27.VIII.2008 (T.J.); Tjeggelvas, 29.VIII.2008 (T.J.).

Hydnellum gracilipes* (P. Karst.) P. Karst.

We have six records. *H. gracilipes* was collected at all three sites. It is a rare mycorrhizal fungus classified as endangered (EN) in Sweden (Gärdenfors 2010). It has also been recorded at a few localities in Denmark and Norway. In Finland it is known from more than a few localities (Kotiranta et al. 2009). Its peculiar morphology and ecology were thoroughly described by Kõljalg & Renvall (2000). *H. gracilipes* is a rarely collected species partly because it prefers to grow in small gaps between fallen logs and soil, and only occasionally spreads on underlying debris. It is suggested to be strongly associated with charred wood. According to our observations, young basidiocarps originate as small sharp-pointed projections on soil, similarly to another hydnaceous fungus; *Phellodon secretus* Niemelä & Kinnunen (Niemelä et al. 2003). However, the latter produces caps only after the tips of these projections touch the wood, while *H. gracilipes* develops pilei before it contacts the above lying substrate. Furthermore, only two specimens out of the six were recorded on charred wood.

Selected specimens studied: **SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, on *P. sylvestris,* 23.VIII.2008 (T.J.); Eggelats, on *P. sylvestris*, 26–27.VIII.2008 (T.J., H). **FINLAND. Etelä-Häme.** Tammela, Mustiala, among mosses on the ground, 20.VIII.1866 *Karsten 3406* (H, lectotype).

Phlebia femsjoeensis* (Litsch. & S. Lundell) J. Erikss. & Hjortstam

We have one record. *P. femsjoeensis* is a very rare, conifer-dwelling species found several times in Norway, Estonia, Finland and Ukraine (Eriksson et al. 1981, Ryvarden et al. 2003, Kotiranta et al. 2009). In Sweden it is known from a few localities in the South-Western part and not previously from northern Sweden. Our specimen grew on a pine log in very late stage of decomposition. It fits well with the description of Eriksson et al. (1981): its spores are ellipsoid, (3.3–)3.4–4.4(–4.6) × (2.0–)2.1–2.8(–3.1) µm (n = 30), and it has clavate cystidia embedded in resinous matrix. The closest relative of *P. femsjoeensis* seems to be *P. radiata* Fr.: Fr., so it belongs to the genus *Phlebia* in strict sense.

***Specimen examined*: SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, on *P. sylvestris,* 23.VIII.2008 (T.J., H).

Phlebia tristis* (Litsch. & S. Lundell) Parmasto

Basidiocarp thin, resupinate, waxy, pale cream-coloured to greyish, hymenophore smooth. *Hyphal system* monomitic; hyphae clamped, thin-walled, 2–3 µm wide. *Basidia* narrowly clavate, four-spored, 18–24 × 4–5 µm. *Cystidia* cylindrical, long, strongly projecting, thin-walled, 80–130 × 5–9 µm, without encrustations. *Spores* allantoid, thin-walled, straight, with a sharply pointed apiculus, (6.0–)6.1–8.1(–8.6) × (1.6–)1.7–2.0(–2.1) µm (n = 60/2), negative in MLZ and CB.

P. tristis was collected twice, in Eggelats and Vaksamvare, both times from relatively thin decorticated pine branches still attached to fallen logs. It is a rare species, found in Sweden, Norway, Spain (Eriksson 1958, Eriksson et al. 1981) and Finland (Kotiranta & Saarenoksa 1993). It belongs to the genus *Phlebia* in wide sense, but there are some similarities between *P. tristis* and some *Crustoderma* species, especially the recently described *C. efibulatum* Kotir. & Saaren (Kotiranta & Saarenoksa 2006). Therefore the true affinities of *P. tristis* must be investigated further. Duhem (2008) combined *P. tristis* into *Crustoderma.*

***Specimens examined*: SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, 23.VIII.2008 (T.J., H); Eggelats, 1.IX.2008 (T.J., H).

Piloderma olivaceum (Parmasto) Hjortstam

Basidiocarp resupinate, pellicular, easily separable from substrate, widely effused along the fallen logs. Hymenophore smooth, often with small craters, firstly yellowish or greyish, later becoming brown; herbarium specimens turning dark, chocolate coloured. Margin clearly rhizomorphic, often bright sulphur yellow (as well as the subiculum and mycelial films in the underlying wood). *Hyphal system* monomitic, hyphae clampless, 1.5–2.5 µm, subicular hyphae with distinct, brownish walls, subhymenial hyphae often embedded in abundant granular brown masses. *Basidia* small, clavate, 12–20 × 4–5 µm, without basal clamps. *Spores* thick-walled, hyaline or pale yellowish in KOH, subglobose, (2.6–)2.8–3.3(–3.5) × (2.0–)2.1–2.8(–2.9) µm (n = 30), strongly cyanophilous.

P. olivaceum was collected once in Tjeggelvas Nature Reserve. It seems to be a relatively rare species confined to the old coniferous forests. *P. olivaceum* has been found in Sweden, Finland, Norway, Russia, and Canada (Parmasto 1967, Eriksson et al. 1981, Renvall 1995, Kotiranta et al. 2009). For a long time, *P. olivaceum* was regarded as an unusual colour form of the common *P. fallax* (Lib.) Stalpers (= *P. croceum* J. Erikss. & Hjortstam, Eriksson et al. 1981). It was recognized as a separate species by Hjortstam (1984). Its main outer feature is the presence of brown tones in the basidiocarp colours. The senescent basidiocarp commonly have brown hymenophore. However, in microscope it is very similar to *P. fallax*, and only differs in having abundant dark-coloured matter among hyphae.

***Specimen examined*: SWEDEN. Norrbotten.** Arjeplog, Tjeggelvas, on *P. sylvestris*, 28.VIII.2008 (T.J., H).

Postia lateritia* Renvall

We have five records. *P. lateritia* was collected in Vaksamvare and Tjeggelvas Nature Reserve. It is a rare species in Sweden and Norway (Renvall 1992, Ryvarden et al. 2003). It is more common in Finland and regarded as a *kelo* -species, dependent on large-diameter pine logs (Niemelä et al. 2002). Very rarely it also occurs on spruce. Its abundance is probably related to climatic factors since *P. lateritia* is relatively common in North-West Russia and further east.

Specimens examined (all on P. sylvestris): **SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, 24.VIII.2008 (T.J.); Tjeggelvas, 30.VIII.2008 (T.J., H). **FINLAND. Pohjois-Karjala.** Lieksa, 3.X.1991 *Niemelä 5547, Penttilä & Renvall* (H, holotype).

Postia parva (Renvall) Renvall

We have nine records. *P. parva* was recorded at all three study sites. This species was recently described as *Oligoporus parvus* (Renvall 2005) but later transferred to genus *Postia* (Kotiranta et al. 2009). *P. parva* is closely related to *P. hibernica* (Berk. & Broome) Jülich It differs from the latter in having long and only slightly curved spores. In contrast to the totally resupinate basidiocarps of *P. hibernica*, *P. parva* may produce small caps. The ecology of this species is also different. *P. parva* grows exclusively on dead pine logs and branches (mainly on fallen *kelo* -trees) while *P. hibernica* grows mostly on spruce logs. Renvall (2005) stated that in old northern pine forests *P. parva* may be more common than previously believed, which is also indicated by our results.

***Selected specimens*: SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, 23 – 24.VIII.2008 (T.J., H); Eggelats, 27.VIII.2008 (T.J., H); Tjeggelvas, 30.VIII.2008 (T.J., H). **FINLAND**. **Kainuu.** Suomussalmi, Hossa, 17.IX.1998 *Junninen 955* (H ex KUO, isotype).

Sistotrema sp. **1**

This fungus was collected twice, in Eggelats. It belongs to the close relatives of *Sistotrema muscicola* (Pers.) S. Lundell, but differs from the other species by strongly hydnoid hymenophore, consisting of long (0.5–3 mm long), thin and sharp spines. In microscope it is characterized by six-sterigmatic basidia and broadly ellipsoid spores (2.2–)2.4–3.7(–3.9) × (2.0–)2.1–3.0(–3.2) µm (n = 60/2). Undoubtedly, it represents a very characteristic and yet undescribed species. Its description will be published in the near future (O. Miettinen, pers. comm.).

***Specimens examined*: SWEDEN. Norrbotten.** Arjeplog, Eggelats, on *P. sylvestris*, 1.IX.2008 (two specimens; T.J., H).

Sistotrema sp. **2**

Basidiocarp very small and thin, seen as whitish pruina on the substrate, consisting of a few (2 or 3) hyphal layers. *Hyphal system* monomitic; hyphae clamped. *Basidia* urniform, 12–14 × 3–4 µm, with two or four sterigmata. *Spores* subglobose, (2.5–)2.8–3.5 × (2.0–)2.1–2.8 µm (n = 30).

This species was collected once, in Tjeggelvas Nature Reserve, growing on a rather thin pine log in intermediate decay stage. Unfortunately, there are no existing names for this taxon. However, we refrain to introduce a new species until more material is available.

***Specimen examined*: SWEDEN. Norrbotten.** Arjeplog, Tjeggelvas, on *P. sylvestris*, 30.VIII.2008 (T.J., H).

Skeletocutis kuehneri* A. David

We have two records. *S. kuehneri* is a rare polypore recorded in both Eggelats and Vaksamvare. It was described from the Mediterranean (David 1982) and its presence in the Nordic countries was indicated relatively recently (Niemelä 1998). Ryvarden et al. (2003) listed 16 localities from Norway, mostly from southern parts of the country, and Niemelä (1998) mentioned this species from three localities in Sweden. In Finland it is relatively rare in the whole country (Kotiranta et al. 2009). *S. kuehneri* prefers to grow on coniferous logs decayed by *Trichaptum* species, mainly *T. abietinum*. In this respect it is similar to some other polypores, for example *Skeletocutis carneogrisea* A. David and *Antrodoella pallasii*.

***Specimens examined*: SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, on dead *T. abietinum* on *P. sylvestris*, 23.VIII.2008 (T.J., H); Eggelats, on *P. sylvestris*, with *T. abietinum* and *Mucronella bresadolae*, 1.IX.2008 (T.J., H).

Trichaptum laricinum* (P. Karst.) Ryvarden

We have five records. This species was found in Vaksamvare and Tjeggelvas Nature Reserve. *T. laricinum* develops on just fallen, and in many cases, corticated logs, and is a species of the first stage of fungal succession. It is circumboreal in its distribution, being found in North Europe, Siberia, and North America (Ryvarden & Gilberson 1994). Niemelä (1985) reported *T. laricinum* to be an important pathogen of spruces in North European timberline regions. All our records derive from fallen pine logs, and the ability of *T. laricinum* to infect living trees of *P. sylvestris* is uncertain.

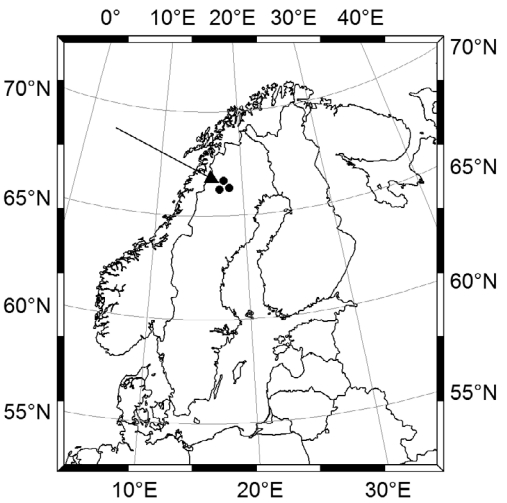


Fig. 1. Location of the three study sites. © Lantmäteriet 1998. From GSD – Roadmap, dnr 507-98-4720

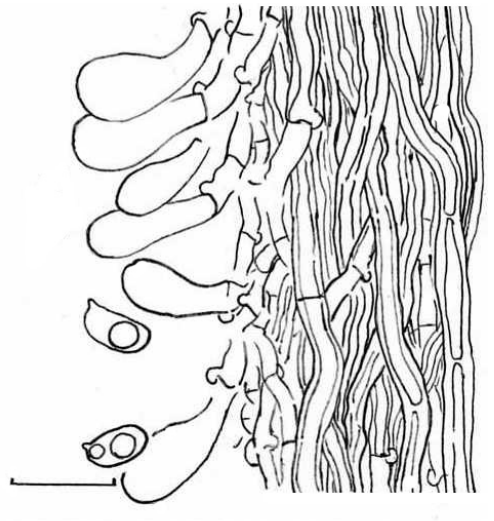
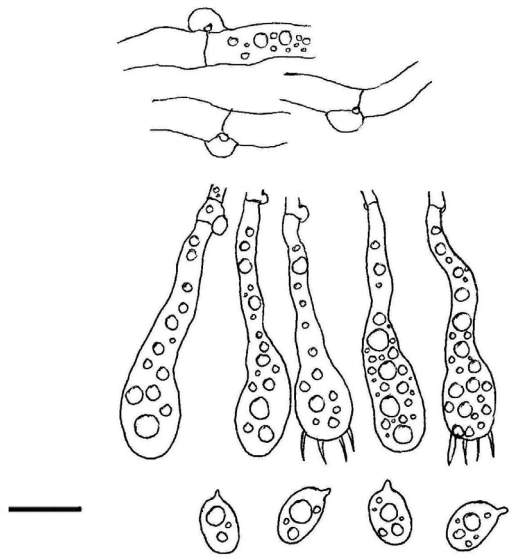


Fig. 2. *Antrodiella pallasii.* Hymenium, trama and basidiospores (Tjeggelvas). Illustration V. A. Spirin. – Scale = 5 µm.

Fig. 3. *Antrodiella pallasii.* Basidiocarp (Tjeggelvas). Photo V. A. Spirin.

Fig. 4. *Ceraceomyces* sp. Subicular hyphae, basidia and spores. (Vaksamvare). Illustration by V. A. Spirin. – Scale = 5 µm.



Selected specimens **studied: SWEDEN. Norrbotten.** Arjeplog, Vaksamvare, 24.VIII.2008 (T.J., H); Tjeggelvas, 29.VIII.2008 (T.J.). **RUSSIA. Baikal.** Listvenichnoye, on *Larix sibirica,* 23.VII.1902 *Lönnbohm* (H, Herb. Karsten 3116*,* lectotype).

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