Karstenia 38:69–80, 1998

Polyporaceae and Corticiaceae of an isolated forest of Abies nephrolepis in Kamchatka, Russian Far East

HEIKKI KOTIRANTA and VICTOR A. MUKHIN

KOTIRANTA, H. & MUKHIN, V. A. 1998: Polyporaceae and Corticiaceae of an isolated forest of Abies nephrolepis in Kamchatka, Russian Far East. – Karstenia 38:69–80. Helsinki. ISSN 0453-3402

The Aphylloporales of an isolated *Abies nephrolepis* forest in Kamchatka were studied in the autumn of 1997. In this study 37 species were found. Their microscopical features are briefly discussed and some measurements are given. The number of species is relatively low. Several species usually common on *Abies* were absent, and our conclusion is that the forest is not native but of anthropogenic origin. The low number of species is explained by the relatively short history of the forest and the poor long-distance dispersal ability of the wood-inhabiting species. The new species *Steccherinum mukhinii* Kotiranta & Y.C. Dai is described.

Key words: Aphyllophorales, Basidiomycetes, *Abies nephrolepis*, Kamchatka, dispersal ability, *Steccherinum mukhinii*

Heikki Kotiranta, Finnish Environment Institute, Nature and Land Use Division, P.O. Box 140, FIN-00251 Helsinki, Finland, email: heikki.kotiranta@vyh.fi

Victor A. Mukhin, Russian Academy of Sciences, Ural Division, Institute of Plant and Animal Ecology, 8 Marta 202, RUS–620219 Ekaterinburg, Russia, email: victor.mukhin@usu.ru

Introduction

As members of the Russian-Scandinavian Trans-Siberian Mycological Expedition the authors had the opportunity to visit the southern part of the Kronotskiy Reserve (Kronotskiy zapovednik; 54° 08' N, 159° 57' E) close to the eastern shore (Bering Sea) of Kamchatka Peninsula on August 21, 1997. Eight kilometres north of the village Zhupanovo there is an *Abies nephrolepis* (Trautv. ex Maxim.) Maxim. (*A. gracilis* Kom.) forest, whose area is about 20 ha. The closest *A. nephrolepis* forests lie in Khabarovsk Territory, about 1 300 km west of the research area.

This is the second mycological inventory in the forest. Parmasto (1963) listed eight wood decaying species and they are added in the list of species below.

The origin of the forest has long been unclear (Komarov 1940), but pollen analyses (Braytseva & Yevteyeva 1967) have shown that it is rather young, and not a glacial relict as it was earlier thought to be (Krishtafovich 1957, Borodin 1978). According to Turkov (1967) the forest is anthropogenic, about a thousand years old. He supposes that the Ainas, who lived on the Kuril Islands, Hokkaido and Sakhalin Island, brought seeds of *A. nephrolepis* to Kamchatka. Today the oldest trees are about 150 years old and the estimated amount of living trees is 180–200 m³/ha. The biggest trees are about 16 metres tall and 25 cm in diameter (Starikov & Dyakonov 1954). A rough estimation of the amount of dead, lying trunks, based on our previous experience in boreal coniferous old-growth forests, is 60–80 m³ (see also Linder 1986, Angelstam 1997, Kuuluvainen et al. 1998, Siitonen et al. 1998). According to Starikov and Dyakonov (1954) about 40–50 % of the trees are damaged or dead. In the forest studied there are a few strongly decayed stumps indicative of old selective cuttings, but no signs of forest fire. All kinds of dead wood of different decay classes (see Renvall 1995) are well presented and the continuity of dead wood is unbroken.

The shrub layer consists of *Sorbaria sorbifolia* (L.) A. Braun, *Lonicera chamissoi* Bunge ex P. Kir., *Juniperus sibirica* Burgsd., *Pinus pumila* (Pallas) Regel, *Rosa acicularis* Lindley and the ground layer of *Maianthemum dilatatum* (Wood) Nels., *Pyrola incarnata* (DC.) Freyn, *Galium verum* L. and *Filipendula camtschatica* (Pall.) Maxim. (Sokolov et al. 1977).

The *A. nephrolepis* forest is surrounded by *Betula ermanii* Cham. forests intermixed with low *Pinus pumila* and few *Alnus viridis* subsp. *fruticosa* (Rupr.) Nyman bushes plus solitary large willows (*Salix* species).

The native coniferous trees of Kamchatka are *Picea jezoensis* (Sieb. & Zucc.) Carriere (*P. ajanensis* Fischer ex Carriere), *Larix gmelinii* subsp. *gmelinii* (Rupr.) Rupr., and bushes of *P. pumila* up to three metres high (Khomentovsky 1995). The sites of spruce and larch, closest to the research area, are about 130 km northwest of the fir woodland, behind the high (1 000 – 2 000 metres) mountain and volcano range (Vostochnyj Khrebet) of the Central-Kamchatka depression (Fig. 1). The depression is 450 km long and up to 50 km wide in the middle (Khomentovsky 1995).

The climate of the fir forest, close to the Bering Sea, is maritime and the annual precipitation is 600 – 800 mm. The temperature in January is –4° to –8° C and in June 8° – 12° C. In summer and autumn, when fungi mostly sporulate (exception: perennial polypores sporulate mostly in spring), winds blow mainly from the Bering Sea (Anonymous 1986).

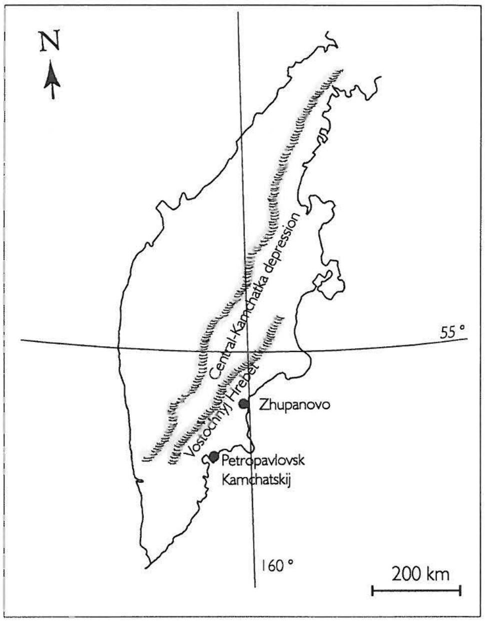

Fig. 1. Kamchatka and the position of *Abies nephrolepis* forest.

The species are arranged alphabetically, regardless of their taxonomic positions. The Tomentelloid fungi are excluded from the list; Kõljalg (1996) recently published an excellent monograph on them in Temperate Eurasia. The nomenclature of Corticiaceae roughly follows Eriksson et al. (1973) and later volumes, of polypores Niemelä (1997) or Hansen and Knudsen (1997) and of vascular plants Sokolov et al. (1977). The species contain no authors' names in the text, if they are included in the above mentioned literature. The specimens are preserved either in the herbarium of the University of Helsinki (H) or in the Institute of Plant and Animal Ecology, Russian Academy of Sciences, Ural Division, Ekaterinburg (IEE) or, in rare cases, in both herbaria. The abbreviation H.K. refers to the reference herbarium of Heikki Kotiranta. The numbers of the senior author's collections, preserved in H, are given in parentheses. For specimens collected by the co-author the abbreviation IEE is used, followed by the number of collected specimens. In the list of species, "*Abies*" means *A. nephrolepis*.

Material and methods

The material was collected in two hours, and the dry material was identified microscopically. The mounting media used were CB (Cotton Blue), IKI (Melzer's reagent) and KOH (5 %). In the verruculose or aculeate spores the spines are included in the measurements. The amount of spores measured vary, but it is usually between ten and twenty, in rare cases even less.

List of species

Aleurodiscus amorphus (Pers.) J. Schröt.
On branches of *Abies* (Parmasto 1963).

Botryobasidium laeve (J. Erikss.) Parmasto

Strongly decayed, decorticate *Abies* (13138). Monomitic. Basal hyphae straight, long-celled, simple septate (two clamps seen), up to 16 µm wide, smooth, with thickened walls. Tramal and subhymenial hyphae simple septate, thin-walled, 5–8 µm wide. Cystidia none. Basidia 16–17 × 6–7 µm, with 6 sterigmata. Spores ellipsoid, smooth with a prominent apiculus, 5.0–5.2 × 2.9–3.1 µm, CB+, IKI–.

Botryobasidium medium J. Erikss.
Decorticate *Abies* (IEE 1 coll.).

Botryobasidium subcoronatum (Höhn. & Litsch.) Donk
Decorticate *Abies* (13126), strongly decayed, decorticate *Abies* (13128). Monomitic, all hyphae clamped, normally up to 8 µm wide (some even 12 µm wide), basal hyphae with thickened walls. Cystidia none. Spores navicular, 7.0–7.2 × 2.9–3.0 µm, CB+, IKI–.

Ceraceomyces microsporus K.H. Larss.
Hard, decorticate *Abies* (13135, IEE 2 coll.). Monomitic, all hyphae clamped and about the same width (2–2.5 µm), thin-walled. No cystidila. Basidia narrowly clavate, basally clamped, with four, up to 4.5 µm long sterigmata, 20–25 (–28) × 3.5–4 µm. Spores broadly ellipsoid to subglobose, (2.6–) 2.8–3.0 × 1.9–2.1 µm, with a negligible apiculus, thin-walled, CB–, IKI–.

Ceraceomyces serpens (Tode : Fr.) Ginns
Syn. *Ceraceomerulius serpens* (Fr.) J. Erikss. & Ryvarden
Corticate *Abies* and branch of *Abies* (13121, 13150, 13160, IEE). Monomitic, all hyphae clamped. Basal hyphae with thickened walls, up to 5 µm wide, sometimes with up to 6 µm wide swellings. Tramal and subhymenial hyphae thin-walled, 2–3 µm wide. Cystidia none. Basidia clavate (16–) 19–24 × 4–5 µm, with four straight, up to 5 µm long sterigmata. Spores short cylindrical to ellipsoid, 3.5–4.0 (–4.3) × 1.8–2.0 (–2.2) µm, thin–walled, CB–, IKI–.

Coniophora olivacea (Fr. : Fr.) P. Karst.
Strongly decayed, decorticate *Abies* (IEE 2 coll.).

Coniophora puteana (Schumach. : Fr.) P. Karst.
Corticate, hard or fairly hard *Abies* (13147, 13148, 13155, IEE 2 coll.). Monomitic, hyphae simple septate, thin-walled. Cystidia none, but up to 2 µm wide hyphidia present between the basidia. Basidia cylindrical, (50–) 75–97 × 8–10 µm, with four, up to 7 µm long curved sterigmata. Spores ellipsoid, adaxial side mostly convex, sometimes straight or slightly concave, (10.8–) 12.0–13.5 (–14.4) × (6.6–) 7.0–8.0 (–9.0) µm, with a negligible apiculus and thickened walls, CB+, IKI– (pale olivaceous or pale brownish; of the same colour as in KOH).
Found also by Parmasto (1963).

Fibulomyces septentrionalis (J. Erikss.) Jülich
Syn. *Leptosporomyces septentrionalis* (J. Erikss.) L.G. Krieglst.
Corticate *Abies* and corticate branch of *Abies* on the ground (IEE 5 coll., H). Monomitic, hyphae clamped throughout. Basal hyphae with slightly thickened walls, up to 8 µm wide. Tramal and subhymenial hyphae 2–3 µm wide, richly branched, thin-walled. Cystidia none. Basidia basally clamped, clavate, 15–17 × 4.5–5 µm, with four short, up to 3.5 µm long sterigmata. Spores subcylindrical to subfusiform, mostly tapering to the apex, often glued in pairs or tetrads, (4.8–) 5.0–6.0 × (1.5–) 1.7–1.9 (–2.0) µm, with an oblique apiculus, thin-walled, CB–, IKI–.

Fibuloporia mucida (Pers. : Fr.) Niemelä
Syn. *Ceriporiopsis mucida* (Pers. : Fr.) Gilb. & Ryvarden
Strongly decayed, decorticate *Abies* (13127). Monomitic, all hyphae with low clamps, 3–3.5 µm wide. Spores broadly ellipsoid to subglobose, 2.8–3.0 × 1.8–2.0 µm, thin-walled, CB–, IKI–.

Globulicium hiemale (Laurila) Hjortstam
Strongly decayed, decorticate *Abies* (13137, IEE 2 coll.). Monomitic, hyphae clamped, 1.5–2 (–3) µm wide. Cystidia none, but apically encrusted hyphidia (1.5 µm in diam) abundant between the basidioles. No mature basidia seen, but basidioles clavate, 36–37 × 12–14 µm. Spores globose to subglobose, 10.0–13.0 × 9.7–12.1 µm, thin–walled, CB–, IKI.

Hymenochaete fuliginosa (Pers.) Lév.
Strongly decayed, decorticate *Abies* (13132, 13153b), corticate part of fairly hard trunk of *Abies* (13151, IEE 2 coll.). Setae dark brown in KOH, (62–) 70–80 × (7–) 8–8.5 µm, sharp pointed, in many cases pitted. Spores cylindrical, 5.5–6.5 × (2.3–) 2.5–2.8 µm, thin-walled, CB–, IKI–.

According to Corfixen (1997) the setae should not be pitted in this species. Collected also by Parmasto (1963).

Hymenochaete tabacina (Sowerby : Fr.) Lév.
Parmasto (1963).

Hyphoderma pallidum (Bres.) Donk

Strongly decayed, decorticate *Abies* (13140). Monomitic, hyphae clamped, thin-walled, with indistinct, brown bodies in subhymenium. Cystidia of two kinds: a) projecting, acute, thin-walled, 25–41 × 5–6.5 µm and b) in the subhymenium and context apically enlarged hyphal ends, 23–35 × 5.5–7 µm, often covered with brownish resinous or oily matter. Basidia cylindrical, 19–25 × 6–7 µm, often with brown oily contents, with four relatively short, up to 3.5 µm long sterigmata. Spores broadly allantoid to subcylindrical, 8.7–9.2 (–9.5) × (3.3–) 3.5–4.0 (–4.2) µm, sometimes with brown, oily contents, thin-walled, CB–, IKI–.

Hyphoderma praetermissum (P. Karst.) J. Erikss. & Å. Strid

Strongly decayed, decorticate *Abies* (13152c). A very small fruit body, which was used up when preparing a single microscopic slide. Monomitic, hyphae clamped. Cystidia (gloeocystidia) fusiform, 47–58 × (9–) 11.5–12 µm. No other cystidia seen. Basidia subclavate, 20–21 × 6–7 µm. Spores ellipsoid, adaxial side mostly convex, seldom concave, (7.1–) 7.5–8.1 (–8.4) × (4.3–) 4.7–5.3 µm, thin–walled.

The spores of this specimen are slightly shorter than usually, but not as short as in *H. subpraetermissum* S.H. Wu (Wu 1997).

Hyphodontia alutaria (Burt) J. Erikss.

Decorticate, strongly decayed *Abies* (13124). Monomitic, all hyphae with thickened walls, clamped. Lagenocystidia abundant, apically sharp, covered by crystalline matter, 24–30 × 3.5–4–5 µm, thick-walled, basally IKI– or weakly dextrinoid, apical part dextrinoid, cyanophilous. Little-differentiated cystidia clamped, projecting over the hymenium, with a rounded head, 34–37 × (4.5–) 5–6 µm (the terminal cell). Spores broadly ellipsoid to subglobose, 4.0–4.3 × 3.0–3.4 µm, CB–, IKI–.

Hyphodontia cf. *aspera* (Fr.) J. Erikss.

Strongly decayed, decorticate *Abies* (13120, 13131, 13156b, 13158), hard, decorticate *Abies* (13136a, 13142), fairly hard, decorticate *Abies* (13141, IEE 3 coll.). Fruit body resupinate, at first white, later creamy, cracking, aculeate. The hymenium between the aculei porose-reticulate (not continuous, smooth). Hyphal system monomitic, hyphae with thickened walls, slightly cyanophilous, clamped, 3–4 µm wide. Cystidia, or rather slightly-differentiated hyphal ends, apically roundish, (18–) 25–31 (–40) × (3–) 3.5–4.5 µm (head up to 6.5 µm wide), often covered by crystal rosettes. Subulate hyphal ends present at the aculeal apices. Basidia subclavate to subcylindrical, (14–) 18–25 × 4–5 µm. Spores ellipsoid to broadly ellipsoid to subglobose, (4.5–) 5.0–5.6 (–6.6) × (3.4–) 3.9–4.2 (–4.4) µm, fairly thin-walled, slightly cyanophilous, IKI–.

Microscopical characteristics of our material very much resemble those seen in *H. aspera*, but the shape of the spores is more roundish in our specimens. The porose reticulate hymenium between the aculei is similar to that in *H. breviseta* (P. Karst.) J. Erikss., but our specimens do not have any kind of gloeocystidia. *H. rimosissima* (Peck) Gilb. also comes close but the spores are narrower, 3.0–3.2 µm (Eriksson 6603, GB). *H. fimbriata* S.H. Wu has longer spores and grows on mountains in warm temperate zone (Wu 1990). Maybe this is just *H. aspera*, but we are not fully convinced.

Hypochniciellum cremeoisabellinum (Litsch.) Hjortstam
Syn. *Leucogyrophana cremeoisabellina* (Litsch.) Parmasto

Fairly hard branch of *Abies* (13144). Monomitic, clamped. Basal hyphae 4 µm wide, straight, with thickened walls and conspicuous clamps. Tramal hyphae 2–3 (–4) µm wide, thin-walled. Cystidia none. Basidia at first clavate, later cylindrical, basally clamped, (23–) 26–32 (–42) × 4.5–5.5 µm, with four, up to 5 µm long sterigmata. Spores ellipsoid, (5.5–) 6.0–6.5 × (3.3–) 3.6–4.0 µm, with a negligible apiculus, thick-walled (up to 0.5 µm), very pale amyloid (grey) or inamyloid.

Kavinia alboviridis (Morgan) Gilb. & Budington

At the base of fairly decayed, corticate stump of *Abies* (13146). Monomitic, hyphae parallel in trama, 4–5 µm wide, in swellings up to 7 µm wide, with slightly thickened walls in basal parts of the aculei, slightly cyanophilous, near the apical end of the aculei thin-walled, 2–3 µm wide. Subhymenial hyphae thin-walled, richly branched, 2–2.5 µm wide. Hyphae clamped (many septa also without a clamp), but the clamps are difficult to discern, because they are very low, and side-branches originate directly from the clamps. Ampullaceous clamps present at the basal parts of the aculei. Cystidia none. Basidia clavate, 20–28 × 5–6 µm, basally clamped. Spores fusiform, (6.7–) 7.0–8.0 (–8.7) × (2.9–) 3.1–3.6 µm, with thickened cyanophilous walls, and strongly cyanophilous warts, IKI golden yellowish.

Laetiporus sulphureus (Bull. : Fr.) Murrill
Strongly decayed *Abies* (IEE 1 coll.). Collected also by Parmasto (1963).

Leucogyrophana romellii Ginns
Decorticate *Abies* (IEE 1 coll.).

Oligoporus rennyi (Berk. & Broome) Donk
Decorticate, fairly strongly decayed *Abies* (13159). An imperfect fruit body, pale citric yellow when fresh. Monomitic, hyphae clamped, 3–4 µm wide, thin-walled. Cystidia none. Basidia none. Chlamydospores globose to subglobose or broadly ellipsoid, 4.0–5.2 × 3.6–4.1 (–4.5) µm, thick-walled, strongly cyanophilous, hyaline in KOH.

The imperfect fruit body of *O. ptychogaster* is brownish, the chlamydospores are ellipsoid, 5.7–6.5 × 4.0–4.5 µm, strongly cyanophilous, yellowish greenish in KOH (Kotiranta 2622 & Niemelä, H, H.K.).

Phanerochaete calotricha (P. Karst.) J. Erikss. & Ryvarden
Corticate *Abies* (IEE 1 coll., H). Monomitic. Basal hyphae thin-walled, often rough, mostly 7–10 µm wide, but sometimes up to 15 µm wide, simple septate, except for few (sometimes verticillate) clamps. Cystidia subulate, narrowing gradually to the roundish tip, 50–60 × 4.5–6 µm, thin-walled, projecting up to 38 µm above the hymenium. Basidia cylindrical to subclavate, basally simple septate, 26–31 × 5 µm, with four, up to 4.5 µm long sterigmata. Spores ellipsoid, 4.4–5.2 (–5.4) × (2.4–) 2.6–2.9 µm, with slightly thickened walls, CB–, IKI–.

Phellinus cf. *microporus* (Pilát) Parmasto
On living *Abies* (13130). Fruit body pileate. Upper surface tomentose. Pores more or less roundish, 2 (–3) per mm. Setae golden brown in IKI, sharp-pointed, 61–88 (–135) × 6.5–9 µm. Spores broadly ellipsoid to ellipsoid, about 5 × 4 µm, with thickened walls.

This specimen closely resembles *P. chrysoloma* (Fr.) Donk, but Fischer (1994) has shown that "*P. chrysoloma*" from the Russian Far East is incompatible with the European species. Thus, we follow here Dai (1996) and call it tentatively *P.* cf *microporus*, which in Siberia lives on *Pinus* and *Abies* (Parmasto & Parmasto 1979).

Phlebiella sulphurea (Pers. : Fr.) Ginns & Lefebre
Syn. *Phlebiella vaga* (Fr.) P. Karst.
Fairly decayed, decorticate *Abies* (13125, IEE 3 coll.). Hymenium turns dark lilac in KOH. Monomitic, clamped. Cystidia none. Basidia pleural, 14–18 × 6–6.5 µm. Spores ellipsoid, (4.8–) 5.0–5.6 (–5.8) × 4.0–4.6 (–4.9) µm, densely verruculose, IKI–.

Piloderma fallax (Liberta) Stalpers
Syn. *Piloderma croceum* J. Erikss. & Hjortstam
Corticate root of *Abies* (13133), strongly decayed, decorticate *Abies* (13139, IEE 1 coll.). Fruit body with yellow rhizomorphs. Monomitic, hyphae simple septate, 2–2.5 (–3) µm wide, thin-walled, cyanophilous, encrusted with rod-like crystals. Cystidia none. Basidia basally simple septate, stalked, clavate, (10–) 14–20 × 4–4.5 µm. Spores broadly ellipsoid to subglobose, 3.0–3.7 × 2.5–3.0 µm, with thickened walls, cyanophilous, IKI–.

According to Eriksson et al. (1981), the spores are acyanophilous.

Postia caesia (Schrad. : Fr.) P. Karst.
Corticate *Abies* (13123, 13157, IEE 1 coll.). Fruit body pileate. Monomitic, clamped. Cystidia none. Spores subcylindrical to suballantoid, (4.3–) 4.5–5.2 (–5.5) × (1.0–) 1.3–1.5 µm, thin-walled, CB–, slightly amyloid.

P. alni (Velen.) Vampola ined. (*P. subcaesia* (David) Jülich f. *minor* Jahn) is very similar in outer appearance, but it seems to grow solely on angiosperms and the spores are only 0.7–1.0 µm wide.

Postia leucomallella (Murrill) Jülich

Parmasto (1963) reported this species from the area as *Tyromyces trabeus* (Rostk. ss. Bourd. & Galz.) Parmasto.

Postia stiptica (Pers. : Fr.) Jülich

Fallen *Abies* (13153, 13154). Fruit body pileate. Pores 4–5 per mm (13154), 7–9 per mm (13153). Taste bitter. Monomitic, hyphae clamped. Contextual hyphae subparallel, slightly thick-walled to thick-walled (walls up to 1.8 µm), up to 5 µm wide. Tramal hyphae with thickened walls, 3–3.5 µm wide, intertwined. Cystidia none, but a few thin-walled, bottle-shaped cystidioles present. Spores short cylindrical, slightly curved, (3.5–) 3.8–4.7 (–6.1) × 1.7–2.0 (–2.3) µm, thin-walled, CB–, IKI–.

Both of the specimens are "typical", but collection number 13153 has very small pores.

Scytinostroma praestans (Jacks.) Donk

In litter, on needles of *Abies* (13129). Dimitic. Generative hyphae clamped, very thin-walled. Skeletals relatively thick-walled, 1 µm wide, cyanophilous, partly dextrinoid. Cystidia of two kinds: a) gloeocystidia tubular, 35–39 × 7µm and b) little-differentiated hyphoid cystidia with schizopapillae. Spores fusiform, 17.2–19.1 × 2.5–3.0 µm, with a negligible apiculus, thin-walled, CB–, IKI–.

We have not seen similar gloeocystidia in the European, West Siberian or Taymyrian material, and the shape of the spores is also different. In Parmasto's (1970) drawing the gloeocystidia and the shape of some spores (the narrow ones) are similar to this specimen.

Sistotrema alboluteum (Bourdot & Galzin) Bondartsev & Singer

On litter of *Abies* and on fine soil (13134). Resupinate, pores 2–3 (–4) per mm. Monomitic, hyphae clamped, thin-walled 3.5–4 µm wide. Gloeoplerous hyphae almost invisible in IKI. Cystidia none. Basidioles pyriform, basidia urniform, 17–22 × 7.5–8 µm, narrowing just before the four, up to 4 µm long sterigmata. Spores broadly ellipsoid to subglobose, 4.4–5.0 (–5.2) × (3.7–) 4.1–4.4 (–4.7) µm, sometimes with a prominent apiculus, with slightly thickened walls, CB–, IKI–.

Steccherinum mukhinii Kotiranta & Y.C. Dai, species nova – Figs. 2–3

Carpophorum annuum resupinatum, hydnaceum. Dentes non ramosi, usque ad 1.5 mm longi, 4–6 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae. Cystidia abundantes, clavata, incrustata. Sporae ellipsoideae vel subglobosae, 2.3–3.1 × 1.8–2.2 µm.

Holotype: China. Jilin Prov., Antu County, Changbaishan Nat. Res., on fallen trunk of corticate *Abies*, 4.IX.1993 *Dai 1045b* (H).

Strictly resupinate, fairly soft, creamy, densely spiny, 7–9 per mm when young, later 4–6 per mm. *Spines* chamois coloured, narrow, pin-like, when young basally often joined together, later solitary, apically penicillate due to the projecting cystidia (seen under × 50) when young, later almost smooth, up to 1.5 mm long. *Hymenium* between the aculei whitish, smooth, cracking when dry. *Margin* white, finely radially fimbriate, without rhizomorphs, loosening from the substrate. *Hyphal system* dimitic. Skeletals 2–3 (–5) µm wide in subiculum, subparallel next to the substrate, randomly orientated in upper parts of the spines, strictly parallel in trama, 3.5–4 (–5) µm, thick-walled (walls up to 2 µm), faintly cyanophilous, IKI–, not changing in KOH. Generative hyphae clamped, fairly thin-walled, 3–4 µm wide in subiculum, thin-walled, 2–3 µm wide, almost invisible in trama. *Cystidia* numerous especially in young apices, later evenly distributed, clavate, fairly robust, thick-walled, heavily encrusted, sometimes with large crystals, 60–160 × (7–) 10–12 µm (the encrusted part). *Basidia* basally clamped, clavate, (10–) 13–14 (–18) × 4–4.5 µm, with four needle-like, up to 2.5 µm long sterigmata. *Spores* broadly ellipsoid to subglobose, 2.6–3.1 × 1.9–2.2 µm, L=2.89, W=2.01, Q=1.27–1.55, Q*=1.43 (n=30, holotype), 2.3–3.0 × 1.9–2.2 µm, L=2.61, W=2.01, Q=1.2–1.5, Q*=1.29 (n=30, Mukhin & Kotiranta), very thin-walled, CB–, IKI–.

S. ochraceum (Fr.) Gray is effused reflexed, much tougher, its hymenium is more reddish (orange), spines more stout, spores larger and ellipsoid. *S. aridum* Svrcek (*S. cremeoalbum* Hjortstam) is simple septate like *S. subcrinale* (Peck) Ryvarden (*S. kavinae* (Pilát) M.P. Christiansen). The aculei of *S. litschaueri* (Bourdot & Galzin) J. Erikss. are more distant, not so densely crowded, and the shape and size of the spores is different. *S. bourdotii* Saliba & David has subglobose to ovoid spores, but they are larger, about 4–5 × 3.3–4.1 µm. The fruit body of *S. murashkinskyi* (Burt) Maas Geest. is robust, effused-reflexed,

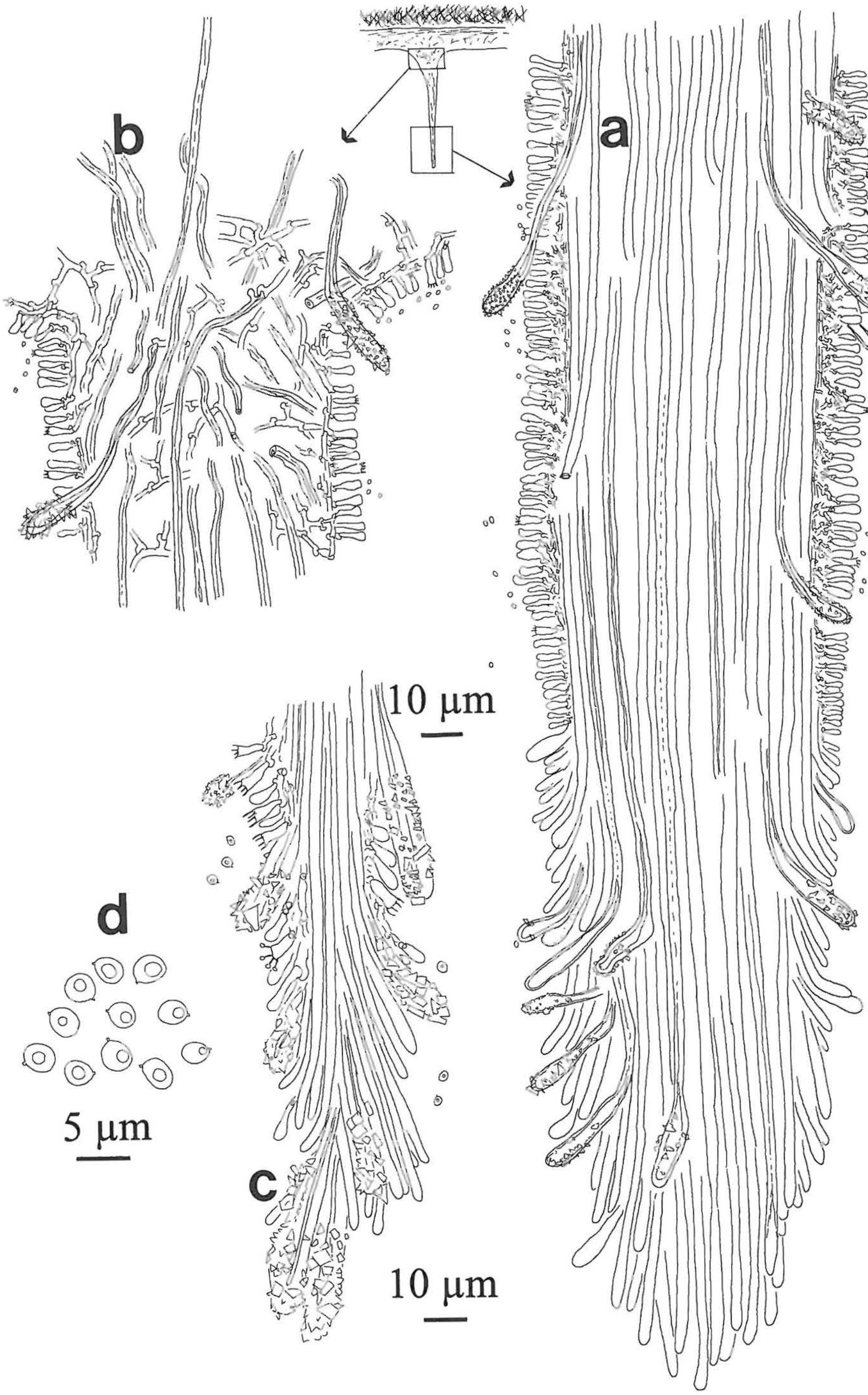

Fig. 2a–d. *Steccherinum mukhinii*. – a) apical part of the spine, b) upper part of the spine, c) apical part of a young spine, d) spores. (*Dai* 1045b a, b, holotypus, *Mukhin & Kotiranta* c, d).

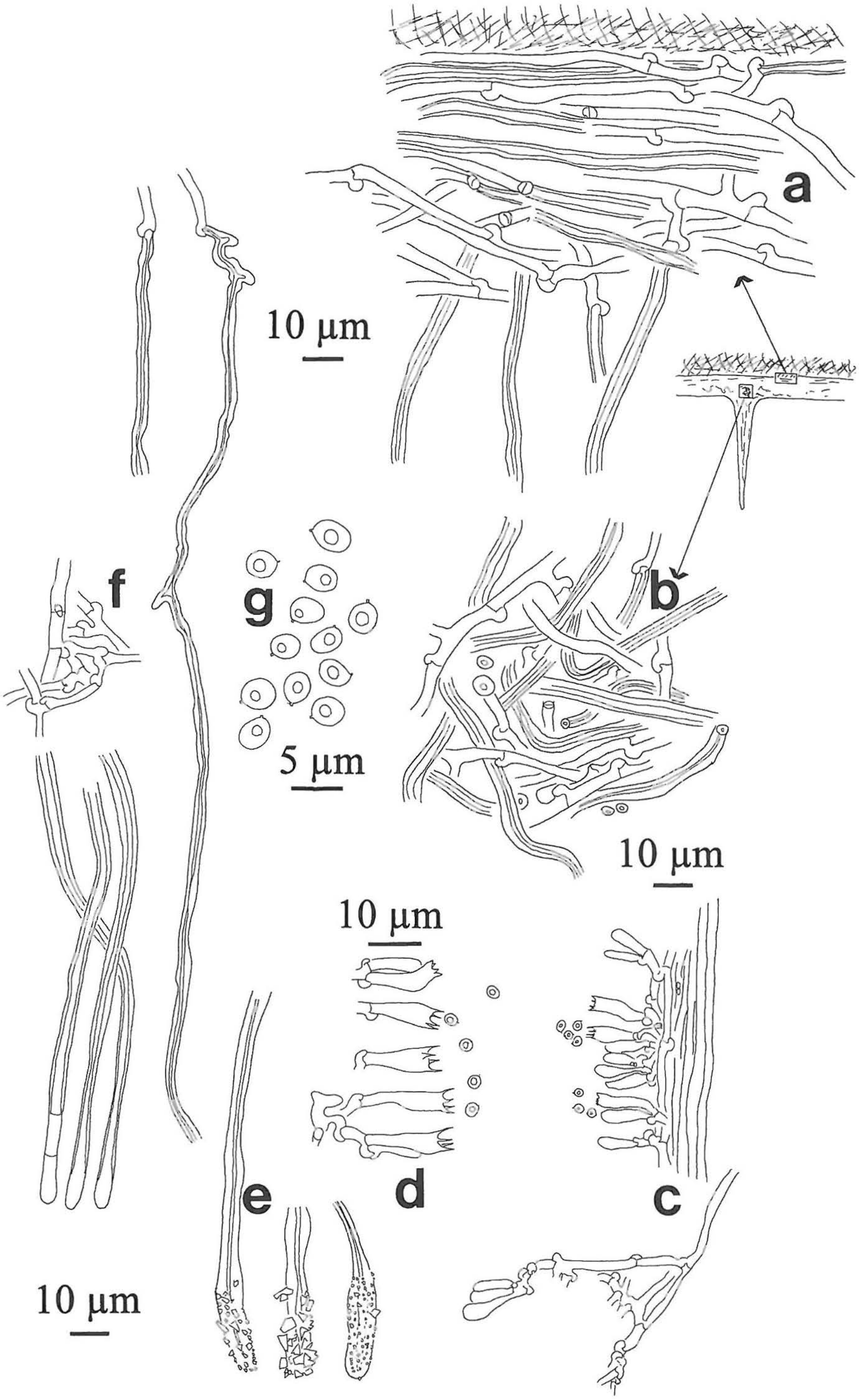

Fig. 3a–g. *Steccherinum mukhinii*. – a) subiculum next to the substrate, b) trama just above the spine, c) hymenium with basidioles and basidia, d) basidia, e) cystidia, f) skeletal hyphae and generative hyphae from the margin of the fruit body, g) spores. (*Dai* 1045b, holotypus).

spores are ellipsoid or thick cylindric, about 3–4 × 1.8–2.2 (Niemelä 1998). Moreover, the spines of *S. murashkinskyi* are 4–5 mm long and cystidia only up to 5 µm wide (Maas Geesteranus 1974).

Dr. Yu–Cheng Dai collected this species from the Changbai forest of northeastern China. There it grew on *Abies*. We here describe it as a new species, because no older name was found for it. The two specimens (Dai 1045b and Mukhin & Kotiranta, see below) differ slightly from each other. The specimen collected by Dai is well developed, weather the other one is young, showing more soft spines and structure. Moreover, in the young specimen there are much more cystidia, especially in the apices of the spines. These cystidia are covered by larger crystals, and the encrusted part is longer. The spores are similar in both specimens, and we believe that the differences are due to different ages of the specimens.

Specimen examined: Russia. Kamchatka, Zhupanovo, on the bark of strongly decayed *Abies nephrolepis*, 21.VIII.1997 Victor A. Mukhin & Heikki Kotiranta (H, IEE).

Stereum sanguinolentum (Alb. & Schwein. : Fr.) Fr.
Parmasto (1963).

Steccherinum separabilimum (Pouz.) Vesterholt
Syn. *Junghuhnia separabilima* (Pouz.) Ryvarden

On the bark of strongly decayed *Abies* (IEE, H.K.). Resupinate, pores 4–5 (–6) per mm. Dimitic. Subiculum: skeletals dominate, 2–4 µm wide, with walls up to 1 µm thick, IKI–; generative hyphae clamped, up to 5 µm wide. Trama: skeletals intertwined, 2–3 µm wide, thick-walled; generative hyphae clamped, 2–3 µm wide, thin-walled. Subhymenial hyphae thin-walled, richly ramified. Cystidia abundant, thick-walled, heavily encrusted, 54–100 × (8–) 10–11 µm. Basidia broadly clavate, 12–14.5 × 5–5.5 µm, with four, up to 2.5 µm long sterigmata. Spores broadly ellipsoid to subglobose, 3.7–4.0 (–4.2) × (2.7–) 3.0–3.2 µm, thin–walled, CB–, IKI–.

S. separabilimum mostly grows on hardwood (c.f. Ryvarden & Gilbertson 1993) and therefore it was compared with the specimen from *Populus tremula* (Finland. Perä-Pohjola: Tervola, Pisavaara Strict Nat. Res., *Kotiranta 9814,* H.K.). The only differences noted were the sharper crystals on cystidia and larger cystidia in this conifer-dweller.

Trechispora farinacea (Bourdot & Galzin) Liberta

Very strongly decayed, decorticate *Abies* (13122), strongly decayed, decorticate *Abies* (IEE 2 coll., H). Monomitic, hyphae clamped, basal ones with thickened walls (13122), others thin-walled, in the middle of the aculei and in apices 5–6 µm broad and 6–10 µm long. Cystidia none. Basidia cylindrical, slightly waisted, 9–12.5 × 4–5 (–5.5) µm, with four, up to 3.5 µm long sterigmata. Spores aculeate, broadly ellipsoid to subglobose, 3.5–4.0 × 3.0–3.5 (–3.7) µm with up to 0.5 µm long warts, slightly cyanophilous, IKI–.

Trechispora stellulata (Bourdot & Galzin) Liberta

Strongly decayed, decorticate *Abies* (13156a). Hyphal system monomitic, hyphae clamped, subhymenial cells almost isodiametric, up to 5–6 µm wide. Cystidia none. Basidia clavate, basally clamped, 8–9 × 4–5 µm. Spores turbinate, 3.5–4.1 × 2.6–3.0 µm, slightly cyanophilous, IKI–.

Tubulicrinis accedens (Bourdot & Galzin) Donk

Strongly decayed, decorticate *Abies* (13119). Monomitic, hyphae clamped. Cystidia capitate, 54–71 × 3–4 µm, thick-walled, except in the up to 6 µm wide round head, IKI–; the capillary lumen gradually widening towards the 2.5–3.5 µm wide neck. Spores ellipsoid, 4.0–4.3 × 2.6–2.8 µm, thin–walled, CB–, IKI–.

Tubulicrinis hirtellus (Bourdot & Galzin) J. Erikss.

Decorticate, fairly decayed *Abies* (IEE 2 coll., H.K.). Monomitic, clamped, hyphae thin- to slightly thick-walled, 3 µm wide. Cystidia subulate, projecting up to 53 µm over the hymenium, 65–82 × 5–6 (–6.5) µm, thick-walled except at the 13–20 µm long thin-walled, often mucronate apex, which sometimes also has short protuberances; cystidia IKI– to very pale grey, the capillary lumen ends abruptly or gradually. Basidia subcylindrical, basally clamped, 12–16 × 4–5 µm, thin-walled, IKI–, with four, almost needle–like, up to 4 µm long straight sterigmata. Spores cylindrical to subfusiform, (6.5–) 7.0–8.0 (–8.3) × 1.9–2.1 (–2.4) µm, thin-walled, CB–, IKI–.

Tubulicrinis subulatus (Bourdot & Galzin) Donk
On bark of *Abies* (IEE 1 coll.).

Tyromyces chioneus (Fr.) P. Karst.
Strongly white-rotted, decorticate *Abies* (IEE 1 coll.).

Vesiculomyces citrinus (Pers.) Hagström
Syn. *Gloeocystidiellum citrinum* (Pers.) Donk

Strongly decayed, decorticate *Abies* (13143, 13145, 13149, IEE 8 coll.). Monomitic, hyphae simple septate, (2–) 2.5–3.5 (–5) µm wide, thin-walled, IKI–. Gloeocystidia vesicular, in trama 45–75 × 21–22 µm, in hymenium fusoid, 60–90 × 7–12 µm. Hyphidia projecting slightly over the basidia, simple septate, with short side-branches, 2 µm wide. Basidia narrowly clavate, basally simple septate, 50 × 7 (only one mature basidium seen). Spores globose to subglobose, (4.7–) 5.0–6.1 × 5.0–6.0 (–6.3) µm, with a prominent apiculus, thin-walled, CB–, weakly amyloid.

According to Parmasto (1963), the species was common in the area also in1960.

Discussion

The number of species found in this fir forest is low, if compared with other, similar-looking boreal old-growth forests with plenty of decaying wood (e.g. Kotiranta & Niemelä 1981, Penttilä 1994, Renvall 1995). According to Lyubarsky and Vasilyeva (1975), the most common polypores on *Abies nephrolepis* in the continental parts of the Okhotsk taiga are *Heterobasidion insulare* (Murr.) Ryvarden, *Fomitopsis pinicola*, *Phellinus hartigii* (Allesch. & Schnabl) Bond., *Pycnoporellus fulgens*, *Trichaptum abietinum* and *T. fuscoviolaceum*. All these species were absent from the forest we studied. Especially striking is the lack or scantiness of many other common decayers which mostly grow on fairly large trunks, like *Antrodia*, *Gloeophyllum*, *Postia*, and *Skeletocutis* species. An obvious explanation would be that we could spend only two hours in the fir forest. However, Parmasto (1963) found only eight species (including two polypores) when he investigated the same forest with the "utmost care". Thus we are convinced that the fir forest really is poor in wood decomposing Aphyllophorales, and a longer study would not add significantly the number of the species.

The poverty of the mycobiota, especially polypores, could be explained by the isolated position of the area and its history, because climatical conditions are not especially severe there. One can imagine that a thousand years are enough for conifer-dwelling polypores to invade the fir forest, only about 130 km away from the nearest coniferous forest. If a closer look is taken at the species composition, only four species seem to be obligatory decayers of conifers, viz. *Aleurodiscus amorphus*, *Botryobasidium medium*, *Phellinus* cf. *microporus* and *Postia caesia*. However, *Botryobasidium medium*, *Phellinus* cf. *microporus* and *Postia caesia* are able to colonize small conifers, like *Pinus pumila*, which grow in the vicinity of the *Abies* forest. *Postia caesia* was also collected there several times from *Pinus pumila*. *Aleurodiscus amorphus* is most common on *Abies* (Eriksson & Ryvarden 1973), but grows also on *Picea*, and there are no records, as far as we know, from *Pinus* in Eurasia (Jülich & Stalpers 1980, Jülich 1984, Breitenbach & Kränzlin 1986, Tellería & Melo 1995, Vesterholt 1997). In North America, too, the most common host is *Abies* (Chamuris 1988), but the species is reported also from *Pinus* (Ginns & Lefebre 1993). Thus, the origin of *Aleurodiscus amorphus* is far from clear, but we believe it did not spring from the surrounding areas inhabited by *Pinus pumila*. This speculation is based on the fact that the spores are faintly coloured (Boidin et al. 1985), very large (Parmasto 1990, Parmasto & Parmasto 1992) for a corticiaceous species, and densely covered with spines. All these features may diminish the mortality of the spores so much that even long dispersal is possible. The aggressive pathogen, *Laetiporus sulpureus*, was found outside (on a large willow) the fir forest, too, and therefore is why we do not regard it as a long-dispersal species. The majority of the species found normally have their optimum on conifers, but can also live on deciduous trees, and only a few are almost solely restricted to angiosperms (*Steccherinum separabilimum*, *Tyromyces chioneus*).

Although the polypores are known to produce huge amount of spores (e.g. Parmasto 1978), their long-dispersal ability seems to be restricted, and most of the spores fall close to their source (fruit body) (e.g. Kallio 1970). The spores of polypores are mostly hyaline and thin-walled, and they are easily killed by the ultraviolet rays in the day time. Kramer and Pady (1968) found that only 6 % of airborne basidiospores are viable.

The absence of *Trichaptum* and *Antrodia* species, and especially *Fomitopsis pinicola* is, in our opinion, strong evidence that polypores lack a good long-dispersal ability. *F. pinicola* was not found outside the fir forest, whereas it is common in the Central Kamchatka depression. *Pycnoporellus fulgens* is also common in central Kamchatka but it is natural that it does not occur here. According to Niemelä (1980), Niemelä et al. (1995), and Kotiranta and Niemelä (1996), it grows only on trees which are first decayed by *F. pinicola*. *Gloeophyllum sepiarium*, a common species in central Kamchatka, was absent from the fir forest. The dense stand was so shady that lack of suitable sun-exposed trunks can also explain the absence. Two species found are threatened in Finland, viz. *Leucogyrophana cremeoisabellina* and *Kavinia alboviridis* (Kotiranta & Niemelä 1996) and one in central Siberia, Yamal peninsula, viz. *Laetiporus sulphureus* (Mukhin & Kotiranta 1997).

Our conclusions are: most species of this isolated forest originate from the surrounding forests and a thousand years are not enough for the wood decaying fungi to occupy new areas, separated by high mountains and a wide sea. This leads to a conclusion that forests having a rich and diverse lignicolous mycoflora must be connected with other forests. It seems to be impossible to "create" artificial old-growth forests with all the fungal elements, if there are no links to source forests through ecological corridors or stepping stones between the forests. This should be taken into consideration when the pristine forests are cut down – in Kamchatka as well as elsewhere.

Acknowledgements: We dedicate this study to Doctor Pjotr Khomentovsky, who died unexpectedly in spring 1998. He took the main responsibility during the Kamchatka expedition. Financial support to Heikki Kotiranta from the Academy of Finland (project No. 38838, 1997) and to Victor A. Mukhin from the Russian Fund for Fundamental Research (No. 96–04–50770) are gratefully acknowledged. Prof. Tuomo Niemelä (University of Helsinki) revised critically the manuscript, and the English language was rewieved by Evgenia Romanova (Ural University); both are very warmly thanked. We also want to thank our unnamed brave guide, who irrespective of the irrational bureaucracy gave us an opportunity to visit briefly the fir forest.

References

Angelstam, P. 1997: Composition of boreal forest in a forest history gradient. – Biodiversity in managed forests – concepts and solutions. Abstarcts, invited papers, voluntary papers & posters. Uppsala, Sweden May 29–31 1997:8. National Board of Forestry et al.

Anonymous 1986: Atlas SSSR 1986. – 260 pp. Glavnoe upravlenie geodezii i kartografii pri Sovete Ministrov SSSR 1986, Moskva.

Boidin, J., Lanquetin, P., Gilles, G., Candoussau, F. & Hugueney, R. 1985: Contribution à la connaissance des Aleurodiscoideae à spores amyloides (Basidiomycotina, Corticiaceae). – Bull. Soc. Mycol. France 101:333–367.

Borodin, A.M. (ed.) 1978: Krasnaya kniga SSSR. Kniga redkikh i nakhodyashchikhsya pod ugrozoy izcheznoveniya vidov zhivotnykh i rasteniy. – 460 pp. Lesnaya Promyshlennost, Moskva.

Braytseva, O.A. & Yevteyeva, I.S. 1967: K istorii jeli i pihty na Kamchatke v chetvertichnoye vremia. – Voprosy geografii Kamchatki 5:144–146.

Breitenbach, J. & Kränzlin, F. 1986: Fungi of Switzerland 2. Non gilled fungi. Heterobasidiomycetes, Aphyllophorales, Gastromycetes. – 412 pp. Verlag Mykologia, Lucerne.

Chamuris, G. P. 1988: The non-stipitate stereoid fungi in the northeastern United States and adjacent Canada. – Mycol. Memoir 14:1–247.

Corfixen, P. 1997: Hymenochaete Lév. In: Hansen, L. & Knudsen, H. (eds), Nordic macromycetes 3. Heterobasidioid, aphyllophoroid and gastromycetoid basidiomycetes. – 445 pp. Nordsvamp, Copenhagen.

Dai, Y.C. 1996: Changbai wood-rotting fungi 7. A checklist of the polypores. – Fung. Sci. 11:79–105.

Eriksson, J. et al. 1973–1988: The Corticiaceae of North Europe 1–8. – 1631 pp. Fungiflora, Oslo.

Fischer, M. 1994: Pairing tests in the Phellinus pini group. – Mycologia 86:524–539.

Ginns, J. & Lefebre, M.N.L. 1993: Lignicolous corticioid fungi (Basidiomycota) of North America. Systematics, distribution, and ecology. – Mycol. Memoir 19:1–247.

Jülich, W. 1984: Die Nichtblätterpilze, Gallertpilze und Bauchpilze (Aphyllophorales, Heterobasidiomycetes, Gasteromycetes). In: Gams, H. (ed.), Kleine Kryptogamenflora 2b(1), Basidiomyceten 1. – 626 pp. Gustav Fischer Verlag, Stuttgart & New York.

Jülich, W. & Stalpers, J.A. 1980: The resupinate non–poroid Aphyllophorales of temperate northern Hemisphere. – Verh. Koninkl. Nederlandse Akad. Wetensch. Afd. Nat.,Tweede Reeks, 74:1–335.

Kallio, T. 1970: Aerial distribution of the root rot fungus Fomes annosus in Finland. – Acta Forestalia Fenn. 107:1–55.

Khomentovsky, P. A. 1995: Ekologiya kedrovogo stlanika na Kamchatke. – 227 pp. Dalnauka, Vladivostok.

Kõljalg, U. 1996: Tomentella (Basidiomycotina) and related genera in Temperate Eurasia. – Synopsis Fungorum 9:1–213.

Komarov, V.L. 1940: Botanicheskiy ocherk Kamchatki. – Kamchatskiy sbornik 1:5–52.

Kotiranta, H. & Niemelä, T. 1981: Composition of the polypore communities of four forest areas in southern Central Finland. – Karstenia 21:31–48.
Kotiranta, H. & Niemelä, T. 1996: Uhanalaiset käävät Suomessa. Threatened polypores in Finland. Second revised edition. – Ympäristöopas 10:1–184.
Kramer, C.L. & Pady, S.M. 1968: Viability of airborne spores. – Mycologia 60:448–449.
Kristafovich, A.N. 1957: Paleobotanika. – 650 pp. Goslestekhizdat.
Kuuluvainen, T,. Syrjänen, K. & Kalliola, R. 1998: Structure of pristine spruce forest in north-eastern Europe. – J. Veget. Sci. (in press).
Linder, P. 1986: Kirjesålandet. En skogsbiologisk inventering av ett fjällnära urskogsområde i Västerbottens län. – 108 pp. Sveriges Lantbruksuniversitet, Institutionen för skoglig Ståndårtslära, Umeå.
Lyubarsky, L.V. & Vasilyeva, L.N. 1975: Derevorazrushajushchije griby Dalnego Vostoka. – 164 pp. Nauka, Novosibirsk.
Maas Geesteranus, R.A. 1974: Studies in the genera Irpex and Steccherinum. – Persoonia 7:443– 581.
Mukhin, V.A. & Kotiranta, H. 1997: Griby. In: Krasnaya Kniga Yamalo-Nenetskogo Avtonomnogo Okruga. – Pp.156–171, 215–220. Izdatel'stovo Uralskogo universiteta, Ekaterinburg.
Niemelä, T. 1980: On Fennoscandian polypores 7. The genus Pycnoporellus. – Karstenia 20:1–15.
Niemelä, T. 1997: Suomen kääpien määritysopas. Guide to the polypores of Finland. 10th revised edition. – Bot. Bull. Helsinki 152:1–127.
Niemelä, T. 1998: Steccherinum bourdotii in North Europe. – Folia Cryptog. Estonica, Fasc. 33:93–97.
Niemelä, T., Renvall, P. & Penttilä, R. 1995: Interactions of fungi at late stages of wood decomposition. – Ann. Bot. Fennici 32:141–152.
Parmasto, E. 1963: K flore gribov poluostrova Kamchatki. In: Issledovanije prirody Dalnego Vostoka. – Pp. 221–289. Akademiya Nauk Estonskoi SSR, Tartu.
Parmasto, E. 1970: The Lachnocladiaceae of the Soviet Union with a key to boreal species. – Scripta Mycol. 2:1–167 + 35 pls.
Parmasto, E. 1978: On the dispersal of Aphyllophoraceous fungi by basidiospores 2. On the dispersal biology of Polyporus squamosus. – Eesti NSV Tead. Akad. Toimetised Biol. 27:149.
Parmasto, I. 1990: Spores of Aleurodiscus amorphus. – Mycotaxon 38:241–243.
Parmasto, E. & Parmasto I. 1979: The xanthochroic reaction in Aphyllophorales. – Mycotaxon 8:201–232.
Parmasto, E. & Parmasto, I. 1992: Size and shape of basidiospores in the Hymenomycetes. – Mycol. Helvetica 5:47–78.
Penttilä, R. 1994: Kainuun vanhojen metsien kääpälajisto. – Metsähallituksen Luonnonsuojelujulkaisuja (Sarja A)35:1–63.
Renvall, P. 1995: Community structure and dynamics of wood-rotting Basidiomycetes on decomposing conifer trunks in northern Finland. – Karstenia 35:1–51.
Siitonen, J., Martikainen, P., Punttila, P. & Rauh, J. 1998: Coarse woody debris and stand characteristics in mature managed and old-growth *Picea abies* forests in southern Finland (manuscript).
Sokolov, S. Ya et al. 1977: Arealy derevyev i kustarnikov SSSR 1. Taxaceae – Aristolochiaceae. – 164 pp. Nauka.
Starikov, G.F. & Dyakonov, N.P. 1954: Lesa poluostrova Kamchatki. – 152 pp. Goslesbumizdat, Khabarovsk.
Tellería, M.T. & Melo, I. 1995: Aphyllophorales resupinatae non poroides, 1. Acanthobasidium – Cystostereum. – Flora Mycol. Iberica 1:1–223.
Turkov, V.G. 1967: Kamchatskaya pihta – botanicheskaya zagadka poluostrova. – Voprosy geografii Kamchatki 5:146–148.
Vesterholt, J. 1997: Aleurodiscaceae Jülich. In: Hansen, L. & Knudsen, H. (eds.), Nordic macromycetes 3. Heterobasidioid, aphyllophoroid and gastromycetoid basidiomycetes. – 445 pp. Nordsvamp, Copenhagen.
Wu, S.H. 1997: New species and new records of Hyphoderma (Basidiomycotina) from Taiwan. – Bot. Bull. Acad. Sin. 38:63–72.

Received on 5 March 1998