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

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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

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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, Kuulu-
vainen 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).

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.
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 x 6–7 μm, with 6 sterigmata. Spores ellipsoid, smooth with a prominent apiculus, 5.0–5.2 x 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 x 2.9–3.0 μm, CB+, IKI-.

Ceraceomyces microsorus K.H. Lars.
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) x 3.5–4 μm. Spores broadly ellipsoid to subglobose, (2.6–) 2.8–3.0 x 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 x 4–5 μm, with four straight, up to 5 μm long sterigmata. Spores short cylindrical to ellipsoid, 3.5–4.0 (–4.3) x 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 x 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) x (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 x 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 x (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 x 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 x 12–14 μm. Spores globose to subglobose, 10.0–13.0 x 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 x (7–) 8–8.5 μm, sharp pointed, in many cases pitted. Spores cylindrical, 5.5–6.5 x (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).


_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 subglobose, (4.5-) 5.0–5.6 (-4.2) μm, sometimes with brown, oily contents, thin-walled, CB−, IKI−.

_Hyphoderma praetermissum_ (P. Karst.) J. Erikss. & Á. 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 ususally, 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-retticate (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 reticate 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. finbriata_ 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. _Leucogyropha cancreoisabellina_ (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. Subhyphal 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, thick-walled, strongly cyanophilous, hyaline in KOH. Chlamydospores globose to subglobose, 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

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. Basidia none. Basidial hyphae simple septate, 2–2.5 (–3) μm wide, thick-walled, 2–3 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.

Phanerochaete calotricha

The imperfect fruit body of Phellinus 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 vaga (Liberta) Stalpers

Syn. Piloderma croceum (P. Karst. & Hjorting)

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 subellaroid, (4.3–) 4.5–5.2 (–5.5) × (1.0–) 1.3–1.5 μm, thin-walled, CB–, slightly amyloid.

Phellinus 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. chrysolooma (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
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) gloecystidia 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 gloecystidia in the European, West Siberian or Taymyrian material, and the shape of the spores is also different. In Parmasto's (1970) drawing the gloecystidia 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 mukhini (Kotiranta & Y.C. Dai, species nova – Figs. 2–3

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 septe 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. murashkinskij (Burt) Maas Geest. is robust, effused-reflexed,
Fig. 2a–d. Stecherinum 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. *Stecherinum 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 \times 1.8–2.2 (Niemelä 1998). Moreover, the spines of *S. murashkinskyi* are 4–5 mm long and cystidia only up to 5 \mu m wide (Maas Geesteranus 1974).

Dr. Yu–Cheng Dai collected this species from the Changbai forest of northeastern China. There it grew on *Abies* and *Fraxinus*, especially in the apices of the spines. These features are due to different ages of the specimens. 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 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.


*Steccherinum separabilum* (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: skeletal cells dominate, 2–4 \mu m wide, with walls up to 1 \mu m thick, IKI--; generative hyphae clamped, up to 5 \mu m wide. Trama: skeletal cells intertwined, 2–3 \mu m wide, thick-walled; generative hyphae clamped, 2–3 \mu m wide, thin-walled. Subhymenial hyphae thin-walled, richly ramified. Cystidia abundant, thick-walled, heavily encrusted, 54–100 \times (8–) 10–11 \mu m. Basidia broadly clavate, 12–14.5 \times 5–5.5 \mu m, with four, up to 2.5 \mu m long sterigmata. Spores broadly ellipsoid to subglobose, 3.7–4.0 (–4.2) \times (2.7–) 3.0–3.2 \mu m, 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 \mu m broad and 6–10 \mu m long. Cystidia none. Basidia cylindrical, slightly waisted, 9–12.5 \times 4–5 (–5.5) \mu m, with four, up to 3.5 \mu m long sterigmata. Spores aculeate, broadly ellipsoid to subglobose, 3.5–4.0 \times 3.0–3.5 (–3.7) \mu m with up to 0.5 \mu m 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 \mu m wide. Cystidia none. Basidia clavate, basally clamped, 8–9 \times 4–5 \mu m. Spores turbinate, 3.5–4.1 \times 2.6–3.0 \mu m, slightly cyanophilous, IKI–.

*Tubulicrinis accedens* (Bourdot & Galzin) Donk

Strongly decayed, decorticate *Abies* (13119). Monomitic, hyphae clamped. Cystidia capitate, 54–71 \times 3–4 \mu m, thick-walled, except in the up to 6 \mu m wide round head, IKI--; the capillary lumen gradually widening towards the 2.5–3.5 \mu m wide neck. Spores ellipsoid, 4.0–4.3 \times 2.6–2.8 \mu m, 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 \mu m wide. Cystidia subulate, projecting up to 53 \mu m over the hymenium, 65–82 \times 5–6 (–6.5) \mu m, thick-walled except at the 13–20 \mu m 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 \times 4–5 \mu m, thin-walled, IKI–, with four, almost needle-like, up to 4 \mu m long straight sterigmata. Spores cylindrical to subfusiform, (6.5–) 7.0–8.0 (–8.3) \times 1.9–2.1 (–2.4) \mu m, thin-walled, CB–, IKI–.
Tubulicrinis subulatus (Bourdot & Galzin) Donk
On bark of Abies (IEE 1 coll.).

Tyromyces chionaeus (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 in 1960.

**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 nephrilepis 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. fusciyolaceum. 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 "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 climatic 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 & Stalspers 1980, Jülich 1984, Breitenbach & Kränzlin 1986, Tellera & 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 sulphureus, 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 separabilium, Tyromyces chionaeus).

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 even during 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 even during the day time. Kramer and Pady (1968) found that only 6% of airborne basidiospores are viable.

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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 lignonicolous 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.

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