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Polypore diversity of Fenglin Nature Reserve, northeastern China

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Field investigations on wood-rotting fungi in Fenglin Nature Reserve, northeastern China, were made in 1999–2002, and nearly 700 specimens were collected by the authors. Based mostly on the collected material, 161 poroid wood-inhabiting species were identified, and this paper gives a checklist of our results. Substrates and collecting data of each species are supplied in the checklist. Five species, *Junghuhnia semisupiniformis* (Murrill) Ryvarden, *Postia ceriflua* (Berk. & M.A. Curtis) Jülich, *Postia rancida* (Bres.) M.J. Larsen & Lombard, *Skeletocutis papyracea* A. David, and *Tyromyces canadensis* Overh. *ex* J. Lowe, are new to China. *Antrodia hingganensis* Y.C. Dai & Penttilä and *Postia amurensis* Y.C. Dai & Penttilä are new to science. The species diversity of polypores in Fenglin Nature Reserve is very high in regional, stand and tree species level when compared with North European data. The number of endemic species is much higher than that known from Europe. A high number of host tree species, lack of Pleistocene glaciations and favourable geography are the likely explanations to the observed high species diversity and level of endemism.

Key words: Basidiomycota, checklist, polypores, species diversity, taxonomy, wood-inhabiting fungi

Introduction

Vascular plants, in particular trees, are richer in species in north-east Asia than in the other parts of Eurasia or in North American boreal and temperate forests (Adams & Woodward 1989, Latham & Ricklefs 1993, Qian & Ricklefs 2000). The higher species diversity in NE Asia has been explained by limited spread of glaciers and consequently lower rates of extinctions during the repeated glacial and interglacial phases in the Pleistocene (Adams & Woodward 1989), and by extreme physiographical heterogeneity in conjunction with climate and sea-level changes, which has created opportunities for evolutionary radiation through allopatric speciation (Qian & Ricklefs 2000, Harrison *et al*. 2001).

The species richness of wood-rotting fungi in north-east Asia is very high (Ryvarden *et al*. 1986, Dai 1996b, 2000, Núñez & Ryvarden 2000, 2001) if compared with that in other boreal or temperate regions in the world (Núñez & Stokland 2000). Lack of Pleistocene glaciations, high diversity of host species and favourable geography (junction of dispersal routes from west, south and east) have been postulated as the main reasons for this high diversity (Dai 1996a, Núñez & Stokland 2000).

Numerous polypore species have been described from northeastern China and Russian Far East (Bondartsev 1961, 1962, 1963, Lyubarsky 1962, Bondartsev & Lyubarsky 1963, 1965, Parmasto 1980, 1982, Dai 1996a, 1998, Núñez *et al*. 2001, Dai & Niemelä 2002), and recently Núñez and Ryvarden (2000, 2001) systematically documented the species of the Ganodermataceae, Hymenochaetaceae and Polyporaceae in East Asia. However, because of the huge areas of little investigated forests in Far East Asia, the knowledge of the polypores is still scanty. In Europe, and especially in Fennoscandia, wood-inhabiting fungi are rather well known; for example in Finland, where the polypore flora is well-studied, 226 species are known (Niemelä 2004). From a single study area in northeastern China, Dai (1996b) reported (Changbai Mountains) almost the same number of polypore species as in the whole of Finland, which is a clear indication of much higher species richness in northeastern China than in Finland. This difference is evidently due to a much higher number of host trees in northeastern China (Dai 1996a), and most probably also because of the slightly lower latitude of the Chinese study area, since increasing species richness with decreasing latitudes is well-established in many taxa (Gaston & Blackburn 2000). However, the past geographic and climatic changes, especially the latest ice ages, cannot be excluded as an explanation for the observed differences. Finland was totally ice-covered for long periods during the glacial maxima whereas northeastern China was predominantly ice-free and consequently formed a refugium for boreal Eurasian species (Elias 1986, Komonen *et al*. 2003).

In this paper, we report polypore species found from the Fenglin Nature Reserve, northeastern China, during field excursions in 1999, 2000 and 2002. Besides the checklist of species and taxonomic studies, we present results from quantitative inventories. They were made in similar habitats (spruce-dominated old-growth forests intermixed with other tree species) and with similar methods as previously in Finnish study areas. This kind of detailed information gives a good background for the comparison of polypore assemblages and their diversity between northern Europe (Finland) and northeastern Asia (Fenglin Nature Reserve). We also identified the host tree species for each polypore collection or observation in order to find out if the number of polypore species on certain host-tree species is higher in northeastern China than in Finland. We hypothesize that if the species number on a certain host is much higher in China than in Finland and if it contains several endemic or non-European species, also factors other than the high number of host-tree species alone are involved in explaining the high species diversity of polypores in northeastern China.

Material and methods

Study area

Fenglin Nature Reserve is situated in Heilongjiang Province, north-east China (48°01´–48°09´N, 128°59´–129°15´E). The reserve is the last virgin forest in the area, having the size of 18 400 hectares. The forest belongs to the hemiboreal vegetation zone. The reserve was mainly established because of its dense virgin stands of Korean pine (*Pinus koraiensis*). It belongs to the Lesser Hinggan Mountains and the altitude varies from 300 m to over 700 m above sea level. The main gymnosperm tree is *Pinus koraiensis*, mixed with *Abies nephrolepis*, *Larix gmelinii*, *Picea jezoensis*, and *Picea koraiensis*; the common angiosperms are *Alnus hirsuta*, *Betula platyphylla*, *Corylus mandshurica*, *Fraxinus mandshurica*, *Lonicera maximowiczii*, *Maackia amurensis*, *Phellodendron amurense*, *Populus davidiana*, *Quercus mongolica*, *Syringa mandshurica*, *Tilia amurensis*, *Ulmus propinqua*, and several species of *Acer* and *Salix*.

Taxonomy

The specimens collected by Yu-Cheng Dai (YCD) are mostly deposited at the herbarium of Institute of Applied Ecology, Chinese Academy of Sciences (IFP), and the material collected by

Reijo Penttilä (RP) and some duplicates of YCD are preserved at the Botanical Museum of the University of Helsinki (H). For comparison, reference material from H was also studied.

The microscopic routine used in the study is as presented by Dai (1996b). In the text the following abbreviations are used: *L* (*L**) = variation of mean spore length among the specimens studied (*L** = the mean of all spores from the studied specimens), *W* (*W**) = variation of mean spore width among the specimens studied (*W** = the mean of all spores from the studied specimens), *Q* = variation in the *L*/*W* ratios among the specimens studied (quotient of the mean spore length and the mean spore width), *n* = (*x*/*y*) the number of spores (pores, hyphae and cystidioles) measured from a given number of specimens. In presenting the variation in the size of spores (pores and hyphae), 5% of the measurements were excluded from each end of the range, and are given in parentheses; IKI stands for Melzer's reagent and KOH for 5% potassium hydroxide, and CB is the abbreviation of Cotton Blue. CB+ means cyanophilous and CB– acyanophilous; IKI– means both inamyloid and indextrinoid.

Inventories

The first, one-week inventory was made in July 1999, the second during three weeks in late July to August 2000 and the third one-week inventory in September of 2002. In general, species diversity and ecology of polypores were followed during each trip by counting both the numbers and abundances of the species in the field. Also the host tree species of each collection was identified, whenever possible. Most of the inventories were made in *Picea* and *Abies* dominated forests, but also pine (*Pinus koraiensis)* and deciduous forests were visited.

In addition to the "normal" inventories, a specific quantitative inventory of polypore flora was done in two sample plots in Fenglin to compare the species richness between boreal old-growth forests of southern Fennoscandia (Finland) and north-east Asia. Similar inventory methods, in which the time spent in the study area was connected to the amount of dead wood in that area, were used both in Fenglin Nature Reserve and in Fennoscandian study areas. In Fenglin the sizes of the sample plots were 3 and 4 ha, and the active searching time spent in the sample plot was 14 and 11 hours, respectively. Both sample plots were dominated by *Picea* (*P. jezoensis* and *P. koraiensis*) and *Abies* (*A. nephrolepis*), intermixed with *Pinus koraiensis* and *Betula platyphylla* and several other deciduous tree species. The amount of dead wood was very high in both sample plots: about 200 m^3 ha^{-1} in the 3-ha plot and between 100–150 m^3 ha^{-1} in the 4-ha sample plot. The number of species, and the abundance and the host tree of each species (or specimen) were investigated from both sample plots. Some of the species were identified already in the field, but over 400 specimens were collected for later identification.

Results

Checklist

In the following a list (alphabetical according to genera) of the polypores is given and, after each name, its substrate and collecting data are supplied. A few species lack collecting data, because they were identified according to the specimens in the exhibition herbarium of the Fenglin Nature Reserve. The authors of scientific names have been abbreviated mostly according to Brummitt and Powell (1992). Polypores are circumscribed here in a wide sense, including the Polyporaceae, Ganodermataceae, and poroid species of the Hymenochaetaceae, Corticiaceae and Tremellaceae. The names marked with an asterisk (*) are new to science, and species in bold are new to China. Some difficult specimens are still unidentified in the material.

Amylocystis lapponica (Romell) Singer, *Picea*, 9.VII.1999 *YCD 3136*

Anomoporia bombycina (Fr.) Pouzar, *Picea*, 3.VIII.2000 *RP 13160 & 13167*

Anomoporia flavissima Niemelä, *Abies*, 12.VIII.2000 *RP 13466*; *Betula*, 5.VIII.2000 *RP 13245*; gymnosperm, 9.IX.2002 *YCD 3741*; *Picea*, 7.IX.2002 *YCD 3625*, 9.VIII.2000 *RP 13411*

Anomoporia myceliosa (Peck) Pouzar, *Abies*, 9.IX.2002 *YCD 3719*

Antrodia albida (Fr. : Fr.) Donk, *Betula*, 29.VII.2000 *RP*

13006, 9.VIII.2000 *RP 13373*; *Picea*, 12.VIII.2000 *RP 13495 & 13506*

Antrodia albobrunnea (Romell) Ryvarden, *Picea*, 2.VIII.2000 *RP 13130*

Antrodia crassa (P. Karst.) Ryvarden, *Larix*, 9.IX.2002 *YCD 3749*; *Picea*, 31.VII.2000 *RP 13040*, *13078 & 13079*, 5.VIII.2000 *RP 13203*, 14.VIII.2000 *RP 13508 & 13510*; *Pinus*, 6.VII.1999 *YCD 3112*

Antrodia gossypium (Speg.) Ryvarden, *Picea*, 5.VIII.2000 *RP 13204*

****Antrodia hingganensis*** Y.C. Dai & Penttilä, *Larix*, 9.IX.2002 *YCD 3748*; *Picea*, 29.VII.2000 *RP 13011*, *Pinus*, 2.VIII.2000 *RP 13146*

Antrodia infirma Renvall & Niemelä, *Picea*, 9.IX.2002 *YCD 3726*; *Pinus*, 1.VIII.2000 *RP 13107*, 4.VIII.2000 *RP 13199*

Antrodia serialis (Fr.) Donk, *Picea*, 8.IX.2002 *YCD 3699*, 30.VII.2000 *RP 13043*; *Pinus*, 5.VIII.2000 *RP 13214*

Antrodia sitchensis (Baxter) Gilb. & Ryvarden, *Picea*, 29.VII.2000 *RP 13012*, 30.VII.2000 *RP 13027*, 31.VII.2000 *RP 13049*, 2.VIII.2000 *RP 13122*, *13131*, 5.VIII.2000 *RP 13209 & 13233*, 9.VIII.2000 *RP 13342*, 7.IX.2002 *YCD 3604 & 3617*; *Pinus*, 1.VIII.2000 *RP 13106*, 12.VIII.2000 *RP 13449*

Antrodia vaillantii (DC. : Fr.) Ryvarden, *Pinus*, 12.VIII.2000 *RP 13446*

Antrodia xantha (Fr. : Fr.) Ryvarden, angiosperm, 7.VIII.2000 *RP 13309*; *Picea*, 9.IX.2002 *YCD 3715*, 2.VIII.2000 *RP 13112*, 9.VIII.2000 *RP 13347*; *Pinus*, 4.VIII.2000 *RP 13198*, 5.VIII.2000 *RP 13249*; *Quercus*, 9.VII.1999 *YCD 3129*

Antrodiella citrinella Niemelä & Ryvarden, *Pinus*, 7.IX.2002 *YCD 3603*

Antrodiella gypsea (Yasuda) T. Hattori & Ryvarden, *Abies*, 7.IX.2002 *YCD 3614*, 9.IX.2002 *YCD 3730*, 2.VIII.2000 *RP 13124 & 13125*, 5.VIII.2000 *RP 13218 & 13259*, 7.VIII.2000 *RP 13301*, 9.VIII.2000 *RP 13419 & 13420*; *Picea*, 31.VII.2000 *RP 13051*, 3.VIII.2000 *RP 13185*, 8.VIII.2000 *RP 13336*, 9.VIII.2000 *RP 13407*, 12.VIII.2000 *RP13475*, *13477 & 13478*

Antrodiella pallasii Renvall, Johannesson & Stenlid, *Picea*, 9.IX.2002 *YCD 3717*

Antrodiella semisupina (Berk. & M.A. Curtis) Ryvarden *sensu lato*, *Betula*, 8.VIII.2000 *RP 13318*

Antrodiella ussurii Y.C. Dai & Niemelä, *Betula*, 31.VII.2000 *RP 13066 & 13077*, 2.VIII.2000 *RP 13120 & 13144*; *Populus*, 8.IX.2002 *YCD 3683 & 3686*

Bjerkandera adusta (Willd. : Fr.) P. Karst., angiosperm, 1.VIII.2000 *RP 13087*, 9.VIII.2000 *RP 13352 & 13399*; *Betula*, 2.VIII.2000 *RP 13123*, 12.VIII.2000 *RP 13472*; *Salix*, 8.IX.2002 *YCD 3644*

Bjerkandera fumosa (Pers. : Fr.) P. Karst., *Salix*, 7.IX.2002 *YCD 3642*; *Tilia*, 10.VIII.2000 *RP 13430*

Castanoporus castaneus (Lloyd) Ryvarden, *Larix*, 9.IX.2002 *YCD 3722*; *Picea*, 9.VIII.2000 *RP 13408*

Ceriporia purpurea (Fr.) Donk, *Alnus*, 9.IX.2002 *YCD 3723*; angiosperm, 8.IX.2002 *YCD 3708*

Ceriporia sp. 1, *Populus*, 8.IX.2002 *YCD 3678*

Ceriporiopsis mucida (Pers. : Fr.) Gilb. & Ryvarden, *Abies*, 3.VIII.2000 *RP 13177*, 10.VIII.2000 *RP 13421*; angiosperm, 2.VIII.2000 *RP 13117*; gymnosperm, 29.VII.2000 *RP 13004*; *Picea*, 1.VIII.2000 *RP 13159*

Ceriporiopsis subrufa (Ell. & Dearn) Ginns, *Betula*, 5.VIII.2000 *RP 13231*

Cerrena unicolor (Bull. : Fr.) Murrill, *Acer*, 31.VII.2000 *RP 13063*; *Ulmus*, 7.IX.2002 *YCD 3589*

Climacocystis borealis (Fr.) Kotl. & Pouzar, *Pinus*, 8.IX.2002 *YCD 3703*

Cryptoporus volvatus (Peck) Shear, *Pinus*, 12.VIII.2000 *RP 13434*

Daedalea dickinsii Yasuda, *Quercus*, 8.IX.2002 *YCD 3695*

Daedaleopsis confragosa (Bolton : Fr.) J. Schroet., *Salix*, 7.IX.2002 *YCD 3590*, 8.IX.2002 *YCD 3646*, 10.VIII.2000 *RP 13433*

Daedaleopsis sinensis (Lloyd) Y.C. Dai, *Alnus*, 7.IX.2002 *YCD 3635*, 8.IX.2002 *YCD 3653 & 3665*, 8.VIII.2000 *RP 13312 & 13317*; angiosperm, 9.VIII.2000 *RP 13333 & 13356 & 13389*, 12.VIII.2000 *RP 13437 & 13458*

Daedaleopsis tricolor (Bull. : Mérat) Bondartsev & Singer, angiosperm, 8.VIII.2000 *RP 13326*, 9.VIII.2000 *RP 13350 & 13404*, 12.VIII.2000 *RP 13457*; *Betula*, 7.IX.2002 *YCD 3602*, 8.VIII.2000 *RP 13328*

Datronia scutellata (Schwein.) Gilb. & Ryvarden, *Alnus*, 8.IX.2002 *YCD 3672 & 3711*

Dichomitus squalens (P. Karst.) D.A. Reid, *Picea*, 7.VII.1999 *YCD 3119*; *Pinus*, 9.VII.1999 *YCD 3130*

Diplomitoporus flavescens (Bres.) Domański, *Pinus*, 9.IX.2002 *YCD 3752*

Diplomitoporus lindbladii (Berk.) Gilb. & Ryvarden, *Larix*, 9.IX.2002 *YCD 3742*; *Picea*, 9.VIII.2000 *RP 13422*, 10.VIII.2000 *RP 13492*; *Salix*, 8.IX.2002 *YCD 3713*

Elmerina holophaea (Pat.) Parmasto, *Betula*, 31.VII.2000 *RP 13071*; *Picea*, 4.VIII.2000 *RP 13206*

Fomes fomentarius (L. : Fr.) Fr., *Betula*, 5.VIII.2000 *RP 13318*

Fomitiporia hartigii (Allesch. & Schnabl) Fiasson & Niemelä, *Abies*

Fomitiporia punctata (P. Karst.) Murrill, *Alnus*, 8.IX.2002 *YCD 3657*; angiosperm, 3.VIII.2000 *RP 13154*

Fomitopsis cajanderi (P. Karst.) Kotl. & Pouzar, gymnosperm, 8.IX.2002 *YCD 3652*; *Larix*, 8.IX.2002 *YCD 3691*; *Picea*, 9.IX.2002 *YCD 3735*, 29.VII.2000 *RP 13007 & 13013*, 5.VIII.2000 *RP 13216 & 13286*, 12.VII.2000 *RP 13505*; *Pinus*, 4.VIII.2000 *RP 13195*

Fomitopsis pinicola (Sw. : Fr.) P. Karst., *Alnus*, 10.VIII.2000 *RP 13432*; angiosperm, 12.VIII.2000 *RP 13459*

Fomitopsis rosea (Alb. & Schwein. : Fr.) P. Karst., *Picea*, 7.VII.1999 *YCD 3118*, 9.VII.1999 *YCD 3131*, *3132 & 3133*, 7.IX.2002 *YCD 3621*; *Pinus*, 7.IX.2002 *YCD 3596*

Funalia cervina (Schwein. : Fr.) Y.C. Dai, *Populus*, 8.IX.2002 *YCD 3680*

Funalia trogii (Berk.) Bondartsev & Singer, *Populus*

Ganoderma lipsiense (Batsch) G.F. Atk., angiosperm, 1.VIII.2000 *RP 13089 & 13100*; *Betula*, 31.VII.2000 *RP 13084*

Ganoderma tsugae Murrill, *Larix*

Gelatoporia pannocincta (Romell) Niemelä, *Abies*, 9.VIII.2000 *RP 13323*; *Betula*, 2.VIII.2000 *RP 13119*, 3.VIII.2000 *RP 13149*, 8.IX.2002 *YCD 3675*; *Picea*

9.VIII.2000 *RP 13327*; *Populus*, 8.IX.2002 *YCD 3681*

Gelatoporia subvermispora (Pilát) Niemelä, *Abies*, 31.VII.2000 *RP 13061*; *Betula*, 31.VII.2000 *RP 13085*; *Picea*, 7.VII.1999 *YCD 3120*, 7.IX.2002 *YCD 3609 & 3631*, 29.VII.2000 *RP 13010*, 30.VII.2000 *RP 13025*, *13026*, *13032*, *13041*, *13044 & 13045*, 31.VII.2000 *RP 13053*, *13055*, *13057*, *13059 & 13075*, 2.VIII.2000 *RP 13113 & 13137*, 3.VIII.2000 *RP 13151*, *13155*, *13172*, *13178*, *13183 & 13184*, 4.VIII.2000 *RP 13193*, *13201 & 13210*, 5.VIII.2000 *RP 13248*, *13251*, *13253*, *13260*, *13263 & 13268*, 9.VIII.2000 *RP 13346 & 13348*, 12.VIII.2000 *RP 13473*; *Pinus*, 1.VIII.2000 *RP 13102*, 5.VIII.2000 *RP 13222*, 9.VIII.2000 *RP 13383*; *Populus*, 8.IX.2002 *YCD 3682*

Gloeophyllum abietinum (Bull. : Fr.) P. Karst., *Larix*, 9.IX.2002 *YCD 3744*; *Picea*, 31.VII.2000 *RP 13024*, 2.VIII.2000 *RP 13129*; *Pinus*, 7.IX.2002 *YCD 3595*

Gloeophyllum odoratum (Wulfen : Fr.) Imazeki, *Picea*, 7.IX.2002 *YCD 3626*, 30.VII.2000 *RP 13209*, 5.VIII.2000 *RP 13239*

Gloeophyllum sepiarium (Wulfen : Fr.) P. Karst., *Picea*, 30.VII.2000 *RP 13023*, 2.VIII.2000 *RP 13134*, 3.VIII.2000 *RP 13186*, 9.VIII.2000 *RP 13416*

Gloeophyllum trabeum (Pers. : Fr.) Murrill, *Betula*, 8.IX.2002 *YCD 3663 & 3664*

Gloeoporus dichrous (Fr. : Fr.) Bres., *Alnus*, 8.IX.2002 *YCD 3712*; angiosperm, 8.IX.2002 *YCD 3655*, 1.VIII.2000 *RP 13088*; *Betula*, 5.VIII.2000 *RP 13241*, 12.VIII.2000 *RP 13463*

Grifola frondosa (Dicks. : Fr.) Gray, ground, 14.VIII.2000 *RP 13512 & 13513*

Haploporus odorus (Sommerf.) Bondartsev & Singer, *Syringa*, 8.IX.2002 *YCD 3673*

Heterobasidion insulare (Murrill) Ryvarden *sensu lato*, *Abies*, 7.IX.2002 *YCD 3601 & 3619*, 5.VIII.2000 *RP 13261*, 8.VIII.2000 *RP 13321*; angiosperm, 2.VIII.2000 *RP 13118*; *Pinus*, 7.IX.2002 *YCD 3597 & 3598*

Inonotus obliquus (Pers. : Fr.) Pilát, *Betula*

Inonotus radiatus (Sowerby : Fr.) P. Karst., *Alnus*, 7.IX.2002 *YCD 3637*, 8.IX.2002 *YCD 3650*; angiosperm, 10.VIII.2000 *RP 13439 & 13460*

Irpex lacteus (Fr. : Fr.) Fr. *sensu lato*, *Betula*, *Populus*

Ischnoderma benzoinum (Wahlenb. : Fr.) P. Karst., *Picea*, 9.IX.2002 *YCD 3753*, 12.VIII.2000 *RP 13504*

Junghuhnia collabens (Fr.) Ryvarden, *Abies* 5.VIII.2000 *RP 13267*; *Picea*, 7.IX.2002 *YCD 3606*

Junghuhnia luteoalba (P. Karst.) Ryvarden, angiosperm, 29.VII.2000 *RP 13014*, 3.VIII.2000 *RP 13181*; *Betula*, 2.VIII.2000 *RP 13141 & 13142*

Junghuhnia nitida (Pers. : Fr.) Ryvarden, angiosperm, 1.VIII.2000 *RP 13109*, 2.VIII.2000 *RP 13116*, 9.VIII.2000 *RP 13363*; *Betula*, 7.IX.2002 *YCD 3636*, 9.VIII.2000 *RP 13351*; *Populus*, 8.IX.2002 *YCD 3685*

Junghuhnia pseudoziligiana (Parmasto) Ryvarden, *Betula*, 8.IX.2002 *YCD 3707*

Junghuhnia semisupiniformis (Murrill) Ryvarden, angiosperm, 1.VIII.2000 *RP 13095*

Laetiporus sulphureus (Bull. : Fr.) Murrill, angiosperm, 8.VIII.2000 *RP 13325*; *Picea*, 7.VII.1999 *YCD 3121b*, 30.VII.2000 *RP 13018 & 13020*

Laricifomes officinalis (Vill. : Fr.) Bondartsev & Singer, *Larix*, 7.VII.1999 *YCD 3122*

Lenzites betulinus (L. : Fr.) Fr., angiosperm, 1.VIII.2000 *RP 13103*; *Betula*, 7.IX.2002 *YCD 3638*, 28.VII.2000 *RP 13001*, 9.VIII.2000 *RP 13401*

Leptoporus mollis (Pers. : Fr.) Quél., *Picea*, 5.VIII.2000 *RP 13262 & 13266*

Leucophellinus irpicoides (Pilát) Bondartsev & Singer, *Acer*, 1.VIII.2000 *RP 13091*

Melanoporia castanea (Yasuda) T. Hattori & Ryvarden, *Quercus*

Oligoporus obductus (Berk.) Gilb. & Ryvarden, *Pinus*, 6.VIII.2000 *RP 13320*

Oligoporus sericeomollis (Romell) Bondartseva, *Picea*, 5.VIII.2000 *RP 13279 & 13283*; *Pinus*, 8.IX.2002 *YCD 3709*, 9.VIII.2000 *RP 13380*

Onnia leporina (Fr.) H. Jahn, *Abies* 12.VIII.2000 *RP 13448*

Oxyporus corticola (Fr.) Ryvarden, *Abies*, 7.VII.1999 *YCD 3116*, 9.VII.1999 *YCD 3134*, 9.IX.2002 *YCD 3736*, 5.VIII.2000 *RP 13217*, *13275 & 13276*, 7.VIII.2000 *RP 13294*, *13304*, *13306 & 13310*, 9.VIII.2000 *RP 13371*, *13376*, *13384*, *13397 & 13417*, 12.VIII.2000 *RP 13441 & 13503*; *Acer*, 31.VII.2000 *RP 13068*; angiosperm, 2.VIII.2000 *RP 13136*, 3.VIII.2000 *RP 13164*, 9.VIII.2000 *RP 13355*; *Betula*, 2.VIII.2000 *RP 13138*, 3.VIII.2000 *RP 13150*, 5.VIII.2000 *RP 13277*, 9.VIII.2000 *RP 13385*, 12.VIII.2000 *RP 13465*; *Picea*, 6.VII.1999 *YCD 3113*, 8.VII.1999 *YCD 3126*, 9.VIII.2000 *RP 13364*, *13365*, *13366 & 13415*, 10.VIII.2000 *RP 13427*

Oxyporus populinus (Schumach. : Fr.) Donk, *Acer*, 8.IX.2002 *YCD 3679*, 12.VIII.2000 *RP 13485*

Parmastomyces mollissimus (Maire) Pouzar, *Betula*, 9.VIII.2000 RP 13331; *Larix*, 9.IX.2002 *YCD 3738*; *Picea*, 30.VII.2000 *RP 13046*, 31.VIII.2000 *RP 13074*, 8.VIII.2000 *RP 13315*, 9.VIII.2000 *RP 13345*, 12.VIII.2000 *RP 13486*; *Pinus*, 9.IX.2002 *YCD 3743*, 4.VIII.2000 *RP 13192*, 8.VIII.2000 *RP 13329*, 9.VIII.2000 *RP 13368*, 12.VIII.2000 *RP 13454*

Perenniporia maackiae (Bondartsev & Ljub.) Parmasto, *Maackia*, 1.VIII.2000 *RP 13111*

Perenniporia narymica (Pilát) Pouzar, angiosperm, 31.VII.2000 *RP 13017*

Perenniporia subacida (Peck) Donk, *Larix*, 8.IX.2002 *YCD 3668*; *Picea*, 7.VIII.2000 *RP 13300*, 9.VIII.2000 *RP 13360*

Phaeolus schweinitzii (Fr. : Fr.) Pat., *Larix*, 28.VII.2000 *RP 13002*; *Picea*, 3.VIII.2000 *RP 13147*, 8.VIII.2000 *RP 13349*, 9.VIII.2000 *RP 13393 & 13412*, 12.VIII.2000 *RP 13487*

Phellinidium ferrugineofuscum (P. Karst.) Fiasson & Niemelä, *Picea*, 9.IX.2002 *YCD 3735*, 31.VII.2000 *RP 13056 & 13082*, 12.VIII.2000 *RP 13475 & 13480*; *Pinus*, 7.IX.2002 *YCD 3623*

Phellinidium sulphurascens (Pilát) Y.C. Dai, *Picea*, 9.IX.2002 *YCD 3746*, 3.VIII.2000 *RP 13189*, 4.VIII.2000 *RP 13200*, 7.VIII.2000 *RP 13293 & 13296*; *Pinus*, 12.VIII.2000 *RP 13507*

Phellinus baumii Pilát, *Syringa*, 6.VII.1999 *YCD 3110*, 8.IX.2002 *YCD 3645 & 3674*, 1.VIII.2000 *RP 13105*, 9.VIII.2000 *RP 13418*

Phellinus ferreus (Pers.) Bourdot & Galzin, angiosperm, 7.VIII.2000 *RP 13297*; *Corylus*, 9.IX.2002 *YCD 3728*; *Tilia*, 7.IX.2002 *YCD 3613*

Phellinus ferruginosus (Schrad. : Fr.) Pat., *Quercus*, 8.IX.2002 *YCD 3697*

Phellinus igniarius (L. : Fr.) Quél. *sensu lato*, *Betula*, 7.VIII.2000 *RP 13292*

Phellinus cf. *laevigatus* (P. Karst.) Bourdot & Galzin, *Betula*, 31.VII.2000 *RP 13070*, 3.VIII.2000 *RP 13179*, 5.VIII.2000 *RP 13254*, 7.VIII.2000 *RP 13305*

Phellinus cf. *laricis* (Jaczewski in Pilát) Pilát, *Larix*, 8.VII.1999 *YCD 3125*, 9.IX.2002 *YCD 3733*, 7.VIII.2000 *RP 13307 & 13308*

Phellinus lundellii Niemelä, *Betula*, 31.VII.2000 *RP 13069*, 4.VIII.2000 *RP 13204*; *Populus*, 8.IX.2002 *YCD 3696*

Phellinus nigrolimitatus (Romell) Bourdot & Galzin, *Abies*, 29.VIII.2000 *RP 13016*; *Picea*, 31.VII.2000 *RP 13060 & 13080*, 9.VIII.2000 *RP 13410*; *Pinus*, 7.IX.2002 *YCD 3629*

Phellinus pini (Brot. : Fr.) A. Ames *sensu lato*, *Pinus*, 7.VII.1999 *YCD 3117*, 8.IX.2002 *YCD 3700*, 1.VIII.2000 *RP 13096*, 5.VIII.2000 *RP 13221*, 9.VIII.2000 *RP 13378*

Phellinus tremulae (Bondartsev) Bondartsev & Borisov, *Populus*, 8.IX.2002 *YCD 3671*

Phellinus vaninii Ljub., *Populus*, 8.IX.2002 *YCD 3677*

Phellinus yamanoi (Imazeki) Parmasto, *Picea*, 9.IX.2002 *YCD 3747*, 1.VIII.2000 *RP 13101*, 8.VIII.2000 *RP 13311*, 9.VIII.2000 *RP 13405*

Physisporinus sanguinolentus (Alb. & Schwein. : Fr.) Pilát, *Abies*, 2.VIII.2000 *RP 13127*, 3.VIII.2000 *RP 13174*, 5.VIII.2000 *RP 13272*, 9.VIII.2000 *RP 13353*; angiosperm, 3.VIII.2000 *RP 13164*; *Betula*, 3.VIII.2000 *RP 13169*, 5.VIII.2000 *RP 13244*; *Picea*, 8.VIII.2000 *RP 13322*

Physisporinus vitreus (Pers. : Fr.) P. Karst., angiosperm, 1.VIII.2000 *RP 13099*; *Betula*, 2.VIII.2000 *RP 13121*, 5.VIII.2000 *RP 13246*, 9.VIII.2000 *RP 13386*

Piptoporus betulinus (Bull. : Fr.) P. Karst., *Betula*

Piptoporus soloniensis (Dubois : Fr.) Pilát, *Quercus*

Polyporus alveolaris (DC. : Fr.) Bondartsev & Singer, *Abies*, 12.VIII.2000 *RP 13452*; *Betula*, 29.VII.2000 *RP 13003*; *Picea*, 6.VII.1999 *YCD 3109*

Polyporus badius (Pers. : Gray) Schwein., *Alnus*, 8.IX.2002 *YCD 3710*; *Betula*, 5.VIII.2000 *RP 13230*, 9.VIII.2000 *RP 13338*; *Quercus*, 9.VII.1999 *YCD 3128*

Polyporus brumalis Pers. : Fr., *Betula*, 7.IX.2002 *YCD 3600*

Polyporus mongolicus (Pilát) Y.C. Dai, *Alnus*, 8.IX.2002 *YCD 3649 & 3651*

Polyporus squamosus (Huds. : Fr.) Fr., *Populus*

Polyporus tubaeformis (P. Karst.) Ryvarden & Gilb., angiosperm, 12.VIII.2000 *RP 13483*; *Pinus*, 10.VIII.2000 *RP 13429*

Poriodontia subvinosa Parmasto, *Abies*, 4.VIII.2000 *RP 13207*, 5.VIII.2000 *RP 13220*, 9.VIII.2000 *RP 13396*

****Postia amurensis*** Y.C. Dai & Penttilä, angiosperm, 7.VIII.2000 *RP 13288*.

Postia caesia (Schrad. : Fr.) P. Karst., *Abies*, 7.IX.2002 *YCD 3622*; *Larix*, 8.IX.2002 *YCD 3666*; *Picea*, 5.VIII.2000 *RP 13227*, 9.VIII.2000 *RP 13358*, 12.VIII.2000 *RP 13494*, *13496*, *13498 & 13502*.

Postia ceriflua (Berk. & M.A. Curtis) Jülich, *Picea*, 5.VIII.2000 *RP 13286*, 8.VIII.2000 *RP 13319*; *Pinus*, 10.VIII.2000 *RP 13462*

Postia fragilis (Fr. : Fr.) Jülich, *Picea*, 3.VIII.2000 *RP 13158*

Postia guttulata (Peck) Jülich, *Picea*, 7.IX.2002 *YCD 3634*; *Pinus*, 7.IX.2002 *YCD 3616*

Postia leucomallella (Murrill) Jülich, *Picea*, 3.VIII.2000 *RP 13155*, 14.VIII.2000 *RP 13509*; *Pinus*, 9.IX.2002 *YCD 3743*

Postia lowei (Pilát) Jülich, *Picea*, 2.VIII.2000 *RP 13132*, 6.VIII.2000 *RP 13278*

Postia placenta (Fr.) M.J. Larsen & Lombard, *Picea*, 29.VII.2000 *RP 13009*, 30.VII.2000 *RP 13034*, 5.VIII.2000 *RP 13208*, 7.VIII.2000 *RP 13304*

Postia rancida (Bres.) M.J. Larsen & Lombard, *Abies*, 5.VIII.2000 *RP 13280*; *Pinus*, 31.VII.2000 *RP 13067 & 13086*

Postia sp. 1, *Picea*, 7.IX.2002 *YCD 3641*

Postia stiptica (Pers. : Fr.) Jülich, angiosperm, 9.VIII.2000 *RP 13334*; *Picea*, 8.IX.2002 *YCD 3701*, 9.VIII.2000 *RP 13357*, 9.VIII.2000 *RP 13414*, 12.VIII.2000 *RP 13469*

Postia subcaesia (A. David) Jülich, *Alnus*, 8.IX.2002 *YCD 3660*; *Populus*, 8.IX.2002 *YCD 3706*

Postia tephroleuca (Fr.) Jülich, *Picea*, 9.IX.2002 *YCD 3727*, 7.VIII.2000 *RP 13289*

Postia undosa (Peck) Jülich, *Picea*, 7.IX.2002 *YCD 3608 & 3633*, 30.VII.2000 *RP 13019 & 13041*, 31.VII.2000 *RP 13072*, 3.VIII.2000 *RP 13162*, 5.VIII.2000 *RP 13284*, 12.VIII.2000 *RP 13442*

Protomerulius caryae (Schwein.) Ryvarden, *Betula*, 2.VIII.2000 *RP 13143*, 5.VIII.2000 *RP 13257 & 13270*; *Populus*, 8.IX.2002 *YCD 3684*

Pycnoporellus fulgens (Fr.) Donk, *Abies*, 7.IX.2002 *YCD 3605*, *3620 & 3632*; *Picea*, 5.VIII.2000 *RP 13215 & 13269*, 9.VIII.2000 *RP 13361*, 10.VIII.2000 *RP 13424 & 13425*, 12.VIII.2000 *RP 13500*

Rigidoporus crocatus (Pat.) Ryvarden, *Abies*, 2.VIII.2000 *RP 13126*, 7.8.2000 *RP 13303*; *Betula*, 8.VIII.2000 *RP 13324*; *Picea*, 9.IX.2002 *YCD 3751*, 31.VII.2000 *RP 13048*, 9.VIII.2000 *RP 13413*, 10.VIII.2000 *RP 13431*

Rigidoporus eminens Y.C. Dai, *Betula*, 7.IX.2002 *YCD 3630*, 31.VII.2000 *RP 13073*, 3.VIII.2000 *RP 13152*, *13171 & 13175*, 4.VIII.2000 *RP 13194 & 13212*, 5.VIII.2000 *RP 13228*, *13240*, *13247 & 13258*, 8.VIII.2000 *RP 13339*, 9.VIII.2000 *RP 13387 & 13394*

Sarcoporia salmonicolor (Berk. & M.C. Curtis) Pouzar, *Pinus*, 10.VIII.2000 *RP 13447*

Schizopora flavipora (Cooke) Ryvarden, angiosperm, 1.VIII.2000 *RP 13090 & 13092*, 3.VIII.2000 *RP 13176 & 13187*; *Betula*, 3.VIII.2000 *RP 13170*, 5.VIII.2000 *RP 13224*; *Larix*, 9.IX.2002 *YCD 3720*; *Picea*, 9.VIII.2000 *RP 13391*, 12.VIII.2000 *RP 13499*

Schizopora paradoxa (Schrad. : Fr.) Donk, *Picea*, 12.VIII.2000 *RP 13476 & 13493*

Schizopora radula (Pers. : Fr.) Hallenb., *Acer*, 3.VIII.2000 *RP 13180*; angiosperm, 5.VIII.2000 *RP 13235*; *Betula*, 3.VIII.2000 *RP 13168*

Skeletocutis biguttulata (Romell) Niemelä, *Picea*, 3.VIII.2000

RP 13157 & 13166, 9.VIII.2000 *RP 13316*, 12.VIII.2000 *RP 13497*; *Pinus*, 9.VIII.2000 *RP 13379*

Skeletocutis brevispora Niemelä, *Picea*, 5.VIII.2000 *RP 13237*, 9.IX.2002 *YCD 3750*

Skeletocutis carneogrisea A. David, *Abies*, 3.VIII.2000 *RP 13173*, 5.VIII.2000 *RP 13219*, 7.VIII.2000 *RP 13302*; *Picea*, 12.VIII.2000 *RP 13450*

Skeletocutis lenis (P. Karst.) Niemelä, *Picea*, 7.IX.2002 *YCD 3611*; *Pinus*, 8.IX.2002 *YCD 3693*, 5.VIII.2000 *RP 13285*, 9.VIII.2000 *RP 13343*, 12.VIII.2000 *RP 13484*

Skeletocutis lilacina A. David & Jean Keller, *Picea*, 9.VIII.2000 *RP 13367*

Skeletocutis nivea (Jungh.) Jean Keller, angiosperm, 27.VII.2000 *RP 13008*, 30.VII.2000 *RP 13047*, 4.VIII.2000 *RP 13213*, 5.VIII.2000 *RP 13236*, 9.VIII.2000 *RP 13398*; *Picea*, 9.VIII.2000 *RP 13340*

Skeletocutis odora (Sacc.) Ginns, *Picea*, 7.IX.2002 *YCD 3599*, 2.VIII.2000 *RP 13133*, 3.VIII.2000 *RP 13163*, 5.VIII.2000 *RP 13242 & 13250*, 12.VIII.2000 *RP 13479 & 13490*; *Pinus*, 7.IX.2002 *YCD 3618*, 9.VIII.2000 *RP 13381*

Skeletocutis papyracea A. David, *Picea*, 5.VIII.2000 *RP 13234*

Skeletocutis stellae (Pilát) Jean Keller, *Picea*, 10.VIII.2000 RP 13467; *Pinus*, 10.VIII.2000 *RP 13445*

Skeletocutis subvulgaris Y.C. Dai, *Abies*, 5.VIII.2000 *RP 13281*; *Picea*, 31.VII.2000 *RP 13083*, 5.VIII.2000 *RP 13229 & 13238*; *Pinus*, 4.VIII.2000 *RP 13197*

Skeletocutis vulgaris (Fr.) Niemelä & Y.C. Dai, *Abies*, 31.VII.2000 *RP 13062*, *Picea*, 7.IX.2002 *YCD 3610*, 29.VII.2000 *RP 13005*, 2.VIII.2000 *RP 13115*, 5.VIII.2000 *RP 13264*, *13265 & 13271*, 12.VIII.2000 *RP 13443*; *Pinus*, 8.IX.2002 *YCD 3692*, 9.VIII.2000 *RP 13369*, 12.VIII.2000 *RP 13435*

Spongipellis spumea (Sowerby : Fr.) Pat., *Alnus*, 8.IX.2002 *YCD 3658*

Trametes conchifer (Schwein. : Fr.) Pilát, *Ulmus*, 8.IX.2002 *YCD 3670*

Trametes gibbosa (Pers. : Fr.) Fr., *Populus*, 8.IX.2002 *YCD 3676*

Trametes hirsuta (Wulfen : Fr.) Pilát, *Alnus*, 8.VIII.2000 *RP 13313*; *Betula*, 7.IX.2002 *YCD 3639*, 5.VIII.2000 *RP 13225*

Trametes ochracea (Pers.) Gilb. & Ryvarden, *Alnus*, 8.IX.2002 *YCD 3647*

Trametes pubescens (Schumach. : Fr.) Pilát, *Alnus*, 8.VIII.2000 *RP 13314*; *Populus*, 8.IX.2002 *YCD 3659*

Trametes suaveolens (Fr. : Fr.) Fr., *Salix*, 7.IX.2002 *YCD 3640*, 8.IX.2002 *YCD 3643*

Trametes velutina (Fr. : Fr.) G. Cunn., *Betula*, 7.IX.2002 *YCD 3592*, 9.VIII.2000 *RP 13372*

Trametes versicolor (L. : Fr.) Pilát, angiosperm, 30.VII.2000 *RP 13028*, 2.VIII.2000 *RP 13128*, 3.VIII.2000 *RP 13182*, 8.VIII.2000 *RP 13344*, 9.VIII.2000 *RP 13392*; *Betula*, 28.VII.2000 *RP 13000*

Trechispora candidissima (Schwein.) Bondartsev & Singer, *Abies*, 9.IX.2002 *YCD 3719 & 3732*; *Pinus*, 8.IX.2002 *YCD 3669*

Trechispora hymenocystis (Berk. & Broome) K.H. Larsson, angiosperm, 9.IX.2002 *YCD 372*; *Picea*, 5.VIII.2000 *RP 13243*, 10.VIII.2000 *RP 13455*

Trechispora mollusca (Pers. : Fr.) Liberta, angiosperm, 2.VIII.2000 *RP 13139*; *Picea*, 30.VII.2000 *RP 13033*, 9.VIII.2000 *RP 13406*

Trichaptum abietinum (Pers. : Fr.) Ryvarden, *Picea*, 5.VIII.2000 *RP 13223*

Trichaptum fuscoviolaceum (Ehrenb. : Fr.) Ryvarden, *Abies*, 9.IX.2002 *YCD 3716*, 2.VIII.2000 *RP 13140*; *Pinus*, 1.VIII.2000 *RP 13097*

Trichaptum laricinum (P. Karst.) Ryvarden, *Larix*, 8.IX.2002 *YCD 3667*

Trichaptum pargamenum (Fr.) G. Cunn., *Betula*, 8.IX.2002 *YCD 3690*

Trichaptum polycystidiatum (Pilát) Y.C. Dai, *Quercus*, 8.IX.2002 *YCD 3698*

Tyromyces canadensis Overh. *ex* J. Lowe, *Pinus* 12.VIII.2000 *RP 13451*

Tyromyces chioneus (Fr.) P. Karst., angiosperm, 5.VIII.2000 *RP 13255*, 9.VIII.2000 *RP 13400*; *Betula*, 8.IX.2002 *YCD 3714*, 9.IX.2002 *YCD 3725*

Tyromyces kmetii (Bres.) Bondartsev & Singer, angiosperm, 10.VIII.2000 *RP 13474*

New taxa

Antrodia hingganensis Y.C. Dai & Penttilä, *sp. nova* (Fig. 1)

Carpophorum annuum vel bienne, *resupinatum*, *facies pororum cremea vel pallido-brunnea*; *pori rotundi*, *3–5 per mm. Systema hypharum dimiticum*, *hyphae generatoriae fibulatae*, *hyphae skeletales subiculi 2–3.5 µm in diam. Sporae cylindricae vel allantoideae*, *IKI–*, *CB–*, *4–5.4 × 1.1–1.5 um.*

TYPE: China. Heilongjiang Prov., Yichun, Fenglin Nature Reserve, on fallen decorticated trunk of *Larix*, 9.IX.2002 *Y.C. Dai 3748* (holotype IFP; isotype H).

ETYMOLOGY: *Hinggan*: the Less Hinggan, a mountain range in north-east China.

Fruitbody: Basidiocarps mostly annual, occasionally biennial, resupinate, difficult to detach, corky to leathery when fresh, corky and light in weight when dry, without odour or taste, up to 25 cm long and 6 cm wide. Pore surface cream coloured, becoming wood coloured or brownish with age, pores mostly round, sometimes angular, 3–5(–6) per mm (n = 60/3); dissepiments thin, mostly entire, sometimes slightly lacerate; margin very narrow to almost lacking. Subiculum cream coloured, corky, up to 0.5 mm thick. Tubes concolorous with pores, corky, up to 1.5 mm long.

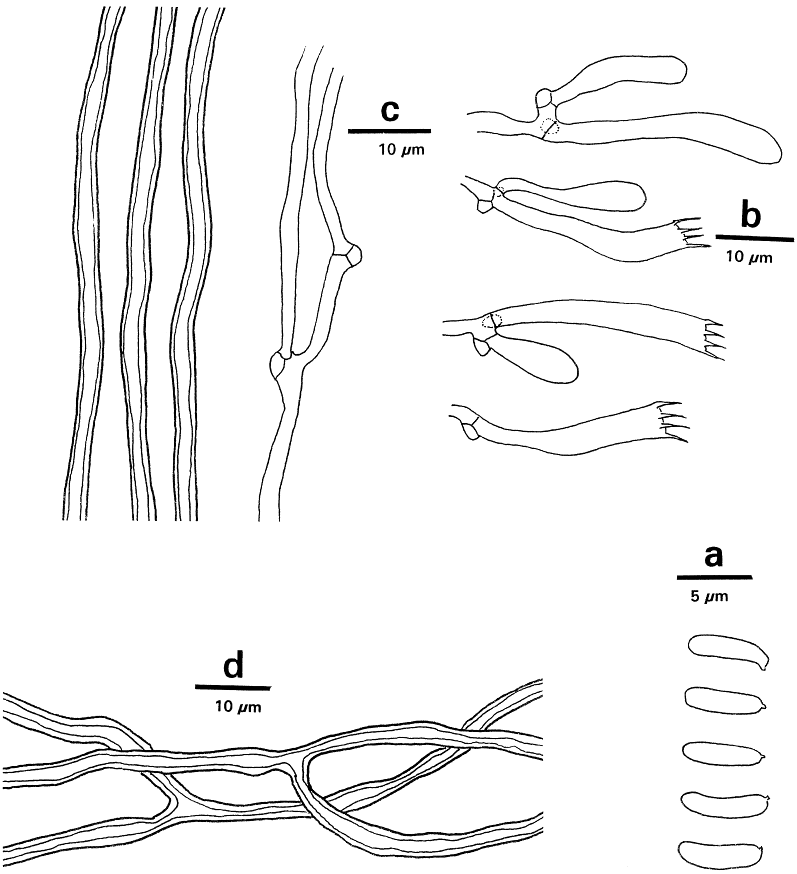

Fig. 1. Microscopic structures of *Antrodia hingganensis* (from holotype). — **a**: Basidiospores. — **b**: Basidia and basidioles. — **c**: Hyphae from trama. — **d**: Hyphae from context.

Hyphal structure: Hyphal system dimitic, generative hyphae with clamp connections, skeletal hyphae dominant in both subiculum and trama, IKI–, CB–, unchanged in KOH.

Subiculum: Generative hyphae infrequent, hyaline, thin-walled, occasionally branched, frequently septate with clamp connections, (1.8–)2–3.2(–3.3) µm in diam. (n = 22/1); skeletal hyphae thick-walled with a narrow lumen to subsolid, flexuous, rarely branched, 2–3.5(–3.6) µm in diam. (n = 24/1).

Tubes: Generative hyphae hyaline, thin-walled, frequently bearing clamp connections and branched, (1.4–)1.5–3(–3.1) µm in diam. (n = 20/1); skeletal hyphae thick-walled with a medium lumen at dissepimental edge, subsolid deeper in trama, unbranched, straight, loosely parallel along tubes, 2–3(–3.3) µm in diam. (n = 20/1). Subhymenium indistinct. Cystidia absent, cystidioles occasionally present, pointed, hyaline, thin-walled, 12–16 × 3.5–4.5 µm (n = 8/1). Basidia clavate, bearing four sterigmata and a basal clamp connection, 14–25 × 4–5 µm; basidioles in shape similar to basidia, but slightly smaller. Some irregular crystals frequently present in trama, especially in hymenium.

Spores: Basidiospores cylindrical to allantoid, hyaline, smooth, thin-walled, CB–, IKI–, (3.8–)4–5.4(–6) × 1.1–1.5(–1.6) µm, L = 4.39–5.15 (L^* = 4.69) µm, W = 1.23–1.31 (W^* = 1.28) µm, Q = 3.35–3.93 (n = 90/3).

ADDITIONAL SPECIMENS EXAMINED (paratypes). — **China**. Jilin Prov., Antu County, Changbaishan Nature Reserve, on charred wood of *Abies*, 28.VII.1993 *Dai 817* (IFP, H); mixed forest, on fallen decorticated trunk of *Pinus*, 14.IX.1998 *Dai 2909 & Niemelä* (IFP, H). Heilongjiang Prov., Yichun, Fenglin Nature Reserve, on fallen wood of *Picea*, 29.VII.2000 *Penttilä 13011*; on fallen trunk of *Pinus*, 2.VIII.2000 *Penttilä 13146*.

Antrodia hingganensis was also found from Changbai Mts., Jilin Province, north-east China; it was treated as *Antrodia* sp. 1 by Dai (1996b), and some collections as *A. sinuosa* by Dai and

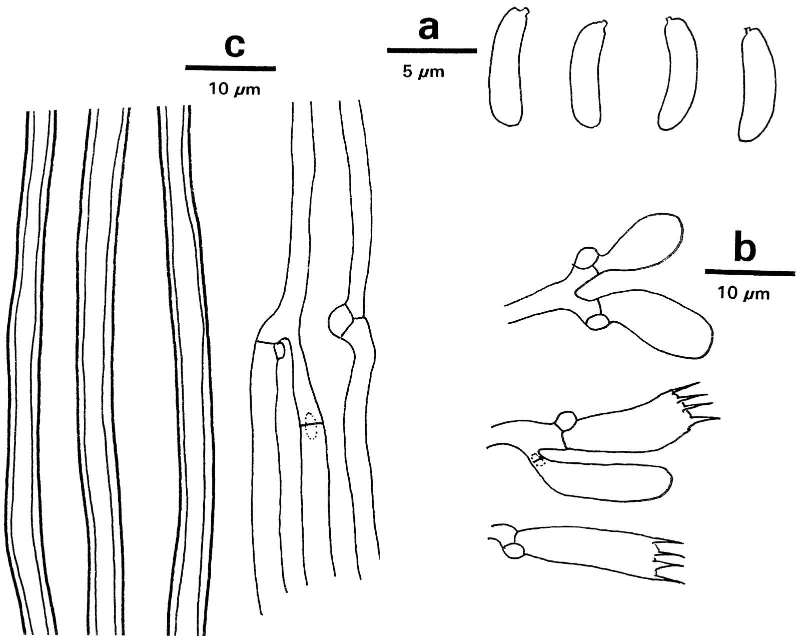

Fig. 2. Microscopic structures of *Antrodia sinuosa* (from *Niemelä 5662).* — **a**: Basidiospores. — **b**: Basidia and basidioles. — **c**: Hyphae from trama.

Niemelä (2002). No doubt *A. hingganensis* is closely related to *A. sinuosa*, and the two species even share a similar ecology: growth on coniferous wood, preferring a dry environment, often charred wood. However, *A. hingganensis* has smaller pores (3–5 per mm, *A. sinuosa* 1–2 per mm) and smaller basidiospores (4–5.4 × 1.1–1.5 μm, *A. sinuosa* 5–6.2 × 1.4–1.9 μm); its skeletal hyphae in trama are thinner (2–3 μm in diam., *A. sinuosa* 3–4 μm in diam.), and its basidia are narrower (15–25 × 4–5 μm, *A. sinuosa* 12–17 × 5–6.5 μm, Fig. 2); its dissepiments are entire or only slightly lacerate when mature, and its texture is corky. The dissepiments of *A. sinuosa* are strongly lacerate and split in mature specimens, and its texture is hard to brittle. Basidiospores in North American material (*Lowe 3383*) are shorter than in European collections, but they are distinctly wider (1.5–1.9 μm) than those in *A. hingganensis*. One specimen from Canada was studied, too, and its basidiospores (5–6.4 × 1.6–2.1) are very similar to the European ones.

According to Ryvarden and Gilbertson (1993) the spores of *Antrodia sinuosa* measure 4–6 × 1–2 μm. When making comparisons, we noted that most of the specimens are sterile or bear a few spores only, and only one Finnish specimen (*Niemelä 5662*) is perfectly fertile; its basidiospores are allantoid, (4.8–)5–6.2(–6.5) × (1.3–)1.4–1.9(–2.0) μm, $L = 5.59$ μm, $W = 1.64$ μm, $Q = 3.41$ ($n = 30/1$).

Antrodia pseudosinuosa was recently described from England by Henrici and Ryvarden (1997). It is a pileate species growing on angiosperms. This species is more closely related to *A. sinuosa*, and it mainly distinguishes from *A. hingganensis* by its bigger pores (1–2 per mm) and larger basidiospores (6–7 × 1.8–2.2 μm).

Antrodia hingganensis is somewhat similar also to *A. albobrunnea* in macrocharacters, but the latter species has a black zone in its subiculum, and its basidiospores are not that small (4.8–6 × 1.5–2 μm *vs.* 4–5.4 × 1–1.5 μm in *A. hingganensis*).

Additional specimens examined. — *Antrodia sinuosa*. **Canada**. Quebec, Gatineau Park, ridge road and parkway, gymnosperm, 7.VIII.1957 *Macrae* (H *ex* DAOM 52749). **Finland**. Uusimaa, Kirkkonummi, Jorvas, Finnträsk, on fallen trunk of *Pinus*, 24.VI.1993 *Niemelä 5662 & Renvall* (H); Nurmijärvi, Klaukkala, on fallen decorticated trunk of *Pinus*, 9.X.1994 *Kotiranta 11848* (H); Sompion Lappi, Pelkosenniemi, Luosto, Kapusta, on charred wood of *Pinus*, 14.VIII.1998 *Dai 2844 & Niemelä* (IFP); Etelä-Häme, Lammi Biological Station, on charred wood of *Pinus*, 11.IX.1997 *Dai 2605* (IFP). **Poland**. Woj. Białostockie, Hajnowka, Puszcza Białowieska, on fallen trunk of *Picea*, 21.V.1996 *Niemelä 5990* (H). **U.S.A**. New York, Newcomb, on bark of angiosperm, 31.VIII.1948 *Lowe 3383* (H). — *Antrodia albobrunnea*. **Finland**. Sompion Lappi, Pelkosenniemi, Luosto, on rotten wood of *Picea*, 3.VIII.1998 *Dai 2747 & Niemelä*

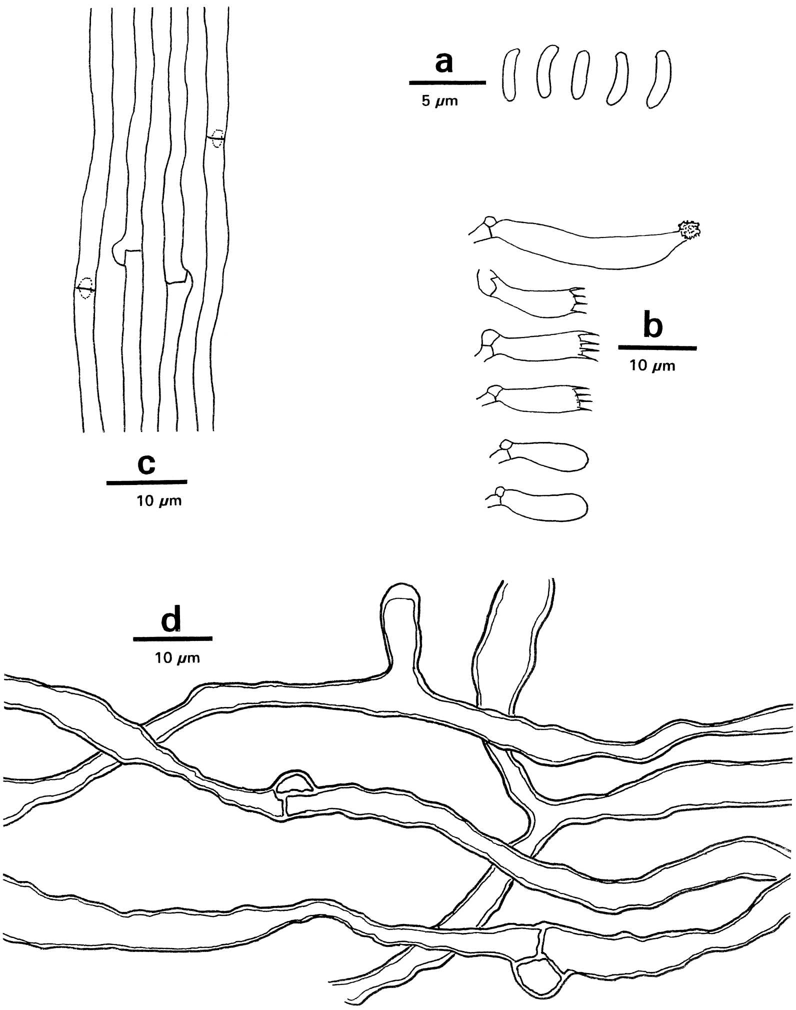

Fig. 3. Microscopic structures of *Postia amurensis* (from holotype). — **a**: Basidiospores. — **b**: Cystidia, basidia and basidioles. — **c**: Hyphae from trama. — **d**: Skeletal hyphae from context.

(IFP). Koillismaa, Oulanka National Park, on charred wood of *Pinus*, 19.IX.1997 *Dai 2710 & Niemelä* (IFP).

Postia amurensis Y.C. Dai & Penttilä, *sp. nova* (Fig. 3)

Carpophorum annuum, pileatum; pori rotundi, 3–4 per mm. Systema hypharum monomiticum, hyphae fibulatae; hyphae contexti tenuitunicatae, 4–7 μm in diam. Cystidia pauca, clavata. Sporae cylindricae vel allantoideae, 4.1–5.2 × 1–1.2 μm.

TYPE: China. Jilin Prov., Antu County, Changbaishan Nature Reserve, on fallen trunk of *Alnus*, 1.IX.1993 *Y.C. Dai 903* (holotype IFP; isotype H).

ETYMOLOGY: Amur, a river between China and Russia in north-east Asia.

Fruitbody: Basidiocarps annual, pileate, solitary or sometimes imbricate. Pilei broadly attached, single pileus up to 5.5 cm wide, projecting up to 3 cm, 1 cm thick at base; soft and watery when fresh, becoming soft corky to slightly fragile when dry. Upper surface velvety and cream coloured when juvenile, becoming glabrous with age, yellowish ochraceous when dry, a thin cuticle present on upper surface, azonate. Pore surface pale cream coloured to yellowish when fresh, becoming pale yellow to yellowish brown when dry. Context cream, corky, up to 6 mm thick. Pores round, 3–4(–5) per mm (n = 40/2); dissepiments thin, entire when juvenile, becoming strongly lacerate with age. Tuber layer concolorous with context, corky, tubes up to 5 mm long.

Hyphal structure: Hyphal system monomitic, generative hyphae bearing clamp connections, all hyphae IKI–, CB–, and unchanged in KOH.

Context: Contextual hyphae hyaline, thin- to slightly thick-walled, occasionally branched and with frequent clamp connections, often collapsed, regularly arranged, (3.5–)4–7(–8) μm in diam. (n = 20/2).

Tubes: Tramal hyphae hyaline, thin-walled, rarely branched, loosely parallel along the tubes, collapsed deeper in trama, (2.3–)2.5–4.5(–5) μm in diam. (n = 20/2). Subhymenium indistinct. Cystidia rarely present, clavate, thin-walled, 30–36 × 3.5–4.5 μm. Basidia clavate, with four sterigmata and a basal clamp connection, 9–15 × 4–5 μm; basidioles similar to basidia in shape, but slightly smaller.

Spores: Basidiospores narrowly cylindric or almost allantoid, hyaline, smooth, thin-walled, CB–, IKI–, (4–)4.1–5.2(–5.5) × 1–1.2(–1.3) μm, L = 4.28–4.62 (L^* = 4.45) μm, W = 1.09–1.11 (W^* = 1.10) μm, Q = 3.93–4.18 (n = 60/2).

ADDITIONAL SPECIMEN EXAMINED (paratype): — **China**. Heilongjiang Prov., Yichun, Fenglin Nature Reserve, on fallen trunk of angiosperm, 7.VIII.2000 *Penttilä 13288* (H).

Postia alni has basidiospores very similar to those of *P. amurensis*. However, *P. alni* has smaller pores (5–7 per mm), thinner context (< 2 mm) and smooth upper surface, and its contextual hyphae are distinctly thick-walled. In addition, *P. alni* has more or less to distinctly greyish or bluish tints in tubes and pore surface, and its basidiospores are bluish in mass.

Postia amurensis is rather similar also to *P. tephroleuca*, but the latter has greyish upper surface, and its context is homogeneous and hard corky. Microscopically *P. tephroleuca* has distinctly thick-walled contextual hyphae, and its basidiospores are wider (3.7–4.4 × 1.3–1.5 μm).

Postia simanii and *P. hibernica* have small and allantoid basidiospores, but these two species are distinguished from *P. amurensis* by having resupinate to effused-reflexed basidiocarps and cream coloured pore surface. In addition, *P. simanii* has smaller pores (5–6 per mm) and abundant cystidia, and *P. hibernica* has entire dissepiments and wider spores (4.0–6.0 × 1.2–1.8 μm).

Postia luteocaesia has cream-coloured to yellowish upper surface and pores, and resembles thus *Postia amurensis*, but has larger basidiospores (5–6 × 2 μm), and its spore print is pale bluish grey.

ADDITIONAL SPECIMENS EXAMINED: — *Postia alni*. **Finland**. Kittilän Lappi, Kittilä, Linkukero, on fallen trunk of *Picea*, 22.IX.2001 *Niemelä 7135* (H). — *Postia hibernica*. **Finland**. Kittilän Lappi, Kittilä, Järvirova, *Pinus*, 6.IX.1960 *Eriksson & Kujala* (H). Koillissmaa, Oulanka National Park, *Pinus*, 17.IX.1997 *Y.C. Dai 2677 & Niemelä (IFP)*. — *Postia luteocaesia*. **France**. Var. Ile de Port Cros, *Pinus*, 12.XII.1992 *Rivorire 733* (H *ex* herb. P. Rivoire). — *Postia simanii*. **China**. Jilin Prov., Antu County, Changbaishan Nat. Res. *Abies*, 3.IX.1993 *Y.C. Dai 1015* (IFP). — *Postia tephroleuca*. **Finland**. Etelä-Häme, Padasjoki, Vesijako Nat. Park, on fallen trunk of *Picea*, 5.X.1985 *Niemelä 3302* (H).

Notes on some additional taxa

Ceriporia sp. 1

Basidiocarp perennial, resupinate, up to 15 cm long, and 5 cm wide. Pore surface pale greyish cream, cracked when dry; pores round, 4–5 per mm, dissepiments thin, entire. Hyphal structure monomitic, hyphae frequently simple septate and branched, covered with crystals in subiculum. No cystidia or cystidioles, basidiospores allantoid, hyaline, smooth, thin-walled, CB–, IKI–, 3–4 × 1.4–1.8 μm.

Ceriporia sp. 1 resembles *C. aurantiocarnescens* by similar basidiospores, but the latter species has annual habit, and its pore surface is orange (Pieri & Rivoire 1997).

Postia sp. 1

Basidiocarp annual, pileate, minute, with a rudimentary stipe. Pileus dimidiate, projecting up to 5 mm, 8 mm wide, and 3 mm thick, upper surface cream coloured, concentrically zonate, smooth, margin blunt. Pore surface cream coloured, pores 4–5 per mm, dissepiments lacerate. Hyphal structure monomitic, hyphae hyaline, thin- to distinctly thick-walled, frequently bearing clamp connections, IKI–, CB–. No cystidia or cystidioles, basidiospores allantoid, hyaline, usually with two guttules, thin-walled, CB–, IKI–, 4–5 × 1.5–2 μm.

Postia sp. 1 is externally very similar to *P. ceriflua*, but the latter species has larger basidiospores (5–6 × 2.5–3 μm).

Diversity studies

In 1999 altogether 78 species were found; in 2000 the number of species increased to 137 and in 2002 the total number of species was 161. Furthermore, about ten difficult specimens are still unidentified, and after their identification the total number of species will most probably rise a little.

The two quantitatively studied sample plots harboured 117 species. The sample plot with 3 ha in size and 14 hours of inventory time hosted 91 species and the other sample plot with 4 ha in size and 11 hours of inventory time hosted 89 species.

The composition of the polypore assemblage in Fenglin Nature Reserve is rather similar to the European polypore flora: of the 161 species in this study 132 species (82%) have also been found from Europe and 116 species (72%) from Finland (Table 1). Altogether 73 species (80 if all the unidentified specimens are included) grew on spruce (*Picea jezoensis* and *P. koraiensis*), of which 60 (82.2%) have also been found from Finland and 64 (87.7%) from Europe. Pine (*Pinus koraiensis)* hosted altogether 42 species (44 if unidentified specimens are included), of which 33 (78.6%) have been found from Finland and 36 (85.7%) from Europe. 25 species (26 if one unidentified specimen is included) grew on *Abies*, 18 species on *Larix* and altogether 89 species (plus two unidentified specimens) on several deciduous tree species. In these trees the proportion of species that occur also in Finland or in the whole of Europe was slightly lower than on spruce and pine (Table 1). The total number of endemic species to East Asia was 21 (13% of all the species; Table 1), and some endemic species might still be added when all the specimens will be successfully identified. The highest number (13) of endemics was found from deciduous hosts followed by spruce (7 species, Table 1). Some of the endemic species were collected from more than one host tree species. Altogether four endemic genera for East Asia, i.e., *Castanoporus*, *Elmerina*, *Leucophellinus* and *Poriodontia*, were found in Fenglin.

The comparison of host specificity of spruce and pine specialist species between Fennoscandia and the Fenglin Nature Reserve (Table 2) shows that a very large proportion of species, which in Finland and Sweden are spruce or pine specialists, grew in Fenglin on several tree species, and in many cases both on coniferous and deciduous hosts. On the other hand, in the material collected from Fenglin there are only four spruce specialists and one pine specialist, which were so abundant that it is reasonable to say something about their host specificity in the study area, and only two of them are species, which in Finland seem to be generalists. The rest of the pine and spruce "specialists" in Fenglin were so rare (only one or two collections) that nothing can be said about their host specificity in the study area.

Discussion

Species diversity

The total number of species (161) found is much higher than has been achieved from boreal study

Table 1. The total number of polypore species and the number of polypore species on each host tree found in the Fenglin Nature Reserve. Proportion (%) of species found in Fenglin, which occur either in Finland or in the whole of Europe, and the number of endemic species in East Asia, are also given for all species and for different host tree species. Finnish and European species lists were checked from Niemelä (2004) and Ryvarden and Gilbertson (1993, 1994).

	All species	*Picea*	*Pinus*	*Abies*	*Larix*	Deciduous trees
Fenglin	161	73	42	25	18	89
Finland	72%	82.2%	78.6%	72%	61.1%	67.4%
Europe	82%	87.7%	85.7%	84%	77.7%	79.8%
Endemic species	21	7	4	4	3	13

areas in northern Europe. For example the total number of polypore species found in restricted old-growth forest areas both in Finland and in European Russia have been at most around 120 species (Penttilä 1994, Hermansson 1997). Moreover, the sampling effort has in many cases been much higher than in Fenglin Nature Reserve. Additionally, Niemelä *et al.* (2001) reported 143 polypore species found from old-growth forests of Russian Karelia, but this number was gained from several inventories made in different boreal regions (hemi-, southern, middle and northern boreal). We know only one inventory which was made in the same (hemiboreal) zone as Fenglin Nature Reserve is situated, namely the Veps Forest, which is a protected old-growth forest area in Leningrad Region, Russia. The sampling effort there was approximately the same as in Fenglin, and altogether 105 polypore species were found (Niemelä *et al.* 2001). Since the inventory was done in late spring and early summer, some annual species were lacking, but the autumn inventory would have raised the species number by not more than 20–30 species. The number of species found from Fenglin is high also when compared with the number of species found from entire countries in northern and central Europe. For example in Sweden (Hallingbäck & Aronsson 1998) and Finland (Niemelä 2001) altogether 210–220 species have been found, and in Germany, Poland and the Czech Republic, which all belong to the temperate region, the number of species found is slightly higher varying between 220–240 species (Ryvarden & Gilbertson 1993, 1994).

The species diversity in Fenglin seems to be very high not only on the regional or landscape level, but also on stand level when compared to inventories made in northern Europe. Inventories made in the best old-growth forests of southern and middle boreal Finland and which have used exactly the same methods as in Fenglin have yielded much lower species richness compared to the two quantitatively studied sample plots in Fenglin. When stands of equal size (3–9 ha) and inventory time (7–10 hours) were compared, the number of species found from the Fenglin sample plots was 15–30 species higher than has been achieved from the best sample plots in Finland.

The number of species found from any single host species was also remarkably high when compared with Fennoscandia. Within one month, 73 species (and seven still unidentified specimens) were collected from spruces, which were the most thoroughly studied tree species in Fenglin. In comparison, approximately 90 species (Kotiranta & Niemelä 1996, Niemelä 2001) have been found during the last 130 years in the whole of Finland.

One explanation for the high species diversity on spruce in Fenglin could be that the fungi in Fenglin seem to be less host specific than they are in Europe. Several species that were more common on other hosts occurred also on spruce. In addition, several species, including *Antrodia albobrunnea*, *A. crassa*, *A. infirma*, *Gelatoporia pannocincta*, *Laetiporus sulphureus*, *Oxyporus corticola*, *Skeletocutis lenis*, *S. nivea* and *Trechispora mollusca*, which in Europe grow either on pine or a deciduous host, grew in Fenglin also on spruce. Also the information in Table 2 highlights strongly that the fungal species in Fenglin seem to be less host specific than in the Nordic countries. Polypores growing in temperate (Tuor *et al.* 1995), and especially in tropical (Lindblad 2000, Gilbert *et al.* 2002) zones have broad host ranges. This phenomenon has been hypothesized to be caused by the greater diversity and thus more dispersed occurrence of hosts in the tropics (May 1991, Lindblad 2000, Gilbert *et al.* 2002).

Table 2. The number of spruce and pine specialists in Finland and Sweden and the number of those specialists which in the Fenglin Nature Reserve were generalists (left column); the number of specialists in Fenglin and the number of those specialists which in Finland and Sweden are generalists (right column). In the brackets are species which in Fenglin were found only once or twice. Specialists in Finland and Sweden were defined as species which either totally or almost totally (over 80% of collections from a single host tree) grow on a single host tree according to the information in Kotiranta and Niemelä (1996), Olofsson (1996) and Niemelä (2004).

	Finland and Sweden		Fenglin Nature Reserve	
	Spruce	Pine	Spruce	Pine
Specialists	23	8	4 (11)	1 (6)
Generalists	12	5	2 (6)	0 (1)

Interestingly, Komonen *et al*. (2003) found also fungivorous insects feeding on polypores to be less host specific in Fenglin than in Finland. They also hypothesized that this could be due to the more heterogeneous forest ecosystem as measured by tree species and forest type diversity in NE China than in Finland. This possibly leads selection towards polyphagy (Beaver 1979). The same explanation may also fit with polypores, but also the lack of Pleistocene glaciations in NE China is most probably an important factor of the high species diversity on different substrates. Since the effect of ice ages was low in NE China and species were not wiped away by glaciers, the wood-rotting fungi had much more stable conditions for development than in northern Europe and Fennoscandia. The lack of Pleistocene glaciations and favourable geography (continuous dispersal routes between East Siberia and South-East Asia for millions of years allowing the coexistence of boreal, temperate and tropical species; Kira 1991, Dai 1996a, Núñez & Stokland 2000) have most likely also been causes for the high number of endemic species in NE Asia as compared with that in other similar regions in the world (Núñez & Stokland 2000). Just from the Fenglin Nature Reserve we found four endemic genera, while only two endemic genera exist in Europe (Núñez & Stokland 2000).

Evidently the high number of host tree species explains a big part of the polypore diversity in NE China (Dai 1996a). The occurrence of two spruce species may also partly explain the high number of species on spruce in Fenglin (in Finland only one). However, the polypore species composition in both spruce species in Fenglin is most probably very similar since they are morphologically and ecologically almost alike. In Fenglin, and elsewhere in NE China the number of deciduous tree species is very high, which also increases the number of polypore species. In Fenglin altogether 89 polypore species were found from deciduous hosts even though they were much less studied than coniferous hosts.

Species composition

Despite many endemic species, a very high percentage of the species found from Fenglin Nature Reserve can also be found from Europe (*see* Table 1), and a great majority of these shared species are in fact circumpolar. Actually the highest number of shared species for polypores and other wood-rotting fungi (Aphyllophorales) can be found from boreal regions (Gilbertson 1980, Hallenberg 1991), and they are most often species utilising coniferous hosts and producing brown rot (Gilbertson 1980, Núñez & Stokland 2000). This can be seen also in our material as the highest number of shared species between Fenglin and Finland or Europe were found from species growing either on spruce or pine (Table 1).

The most common species in the reserve were *Antrodia serialis*, *A. xantha*, *Fomes fomentarius*, *Fomitopsis pinicola*, *F. rosea*, *Gloeophyllum sepiarium*, *Oxyporus corticola*, *Phellinus* cf. *laevigatus*, *Trichaptum abietinum*, *T. fuscoviolaceum*, and the occurences of these species in Fenglin were similar as they are in boreal forests of North Europe. However, unlike in Europe, *Antrodia sitchensis*, *Gelatoporia subvermispora* and *Parmastomyces mollissimus* were rather common in the study area. This phenomenon is interesting: an intensive study was made in Changbai Mts. (NE China), and the vegetation there is rather similar to that in Fenglin. However, in Changbai Mts., *Antrodia sitchensis* was not found at all and *Gelatoporia subvermispora* and *Parmastomyces mollissimus* were rather rare. In addition, *Inonotus obliquus* was very rare in the Fenglin area, while it is very common in the boreal forests of north Europe. *Gloeoporus taxicola* and *Phellinus viticola* are fairly common in old-growth forests of Finland, but were missing from the study area even if the studied forests in Fenglin are rather similar to those in Finland. The following species were recorded in Fenglin, but not found in Europe: *Anomoporia flavissima*, *Antrodiella gypsea*, *A. ussurii*, *Castanoporus castaneus*, *Cryptoporus volvatus*, *Daedalea dickinsii*, *Daedaleopsis sinensis*, *Elmerina holophaea*, *Ganoderma tsugae*, *Heterobasidion insulare*, *Leucophellinus irpicoides*, *Melanoporia castanea*, *Perenniporia maackiae*, *Phellinidium sulphurascens*, *Phellinus vaninii*, *P. yamanoi*, *Polyporus mongolicus*, *Poriodontia subvinosa*, *Rigidoporus eminens*, *Skeletocutis subvulgaris*, *Trametes conchifer* and *Trichaptum polycystidiatum*.

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