Conference Paper

Wood-decaying *Basidiomycetes* Associated with Dwarf Siberian Pine in Northeast Siberia and the Kamchatka Peninsula

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Abstract

A survey of the biodiversity of wood-decaying *Basidiomycetes* associated with *Pinus pumila* (the dwarf Siberian pine), a highly characteristic woody plant of Northeast Siberia and the Kamchatka Peninsula, is presented for the first time. Thirty-two species of wood-decaying *Basidiomycetes* were recorded in the area for this tree, of which twenty-seven were described the first time: 19 species in the Magadan region and 9 in the Kamchatka Peninsula. Communities of wood-decaying fungi associated with *P. pumila* have low biodiversity and consist of 16 species in the Kamchatka Peninsula and 21 species in the Magadan region, with only 5 of them being common to both areas. All fungi associated with dwarf Siberian pine belong to widespread species and are not specialized to this tree: they are extremely low in numbers and their composition strongly varies in different habitats. This shows that this tree does not have its own specialized and stable complex of wood-decaying *Basidiomycetes*.

Keywords: biodiversity, Czekanowski-Sørensen index, host-specialization

1. Introduction

The dwarf Siberian pine – *Pinus pumila* (Pall.) Regel – is a large shrub up to 8 m high with a trunk diameter of up to 18 cm with a lifetime between 300 and 1,000 years. It is widely distributed in Northeast Siberia – the vast territory from the Lena River in the west to the Pacific Ocean in the east (Figure 1). *P. pumila* grows at altitudes from 300–400 to 1900 m above sea level together with *Alnus fruticosa* Rupr., *Larix cajanderi* Mayr and *Betula ermanii* Cham. Some isolated locations of the species are NE Mongolia, NE

China and Korea [1, 2]. In Japan, the southern boundary *P. pumila* is located on Honshu, where it grows at altitudes of 2300–3000 m [3].

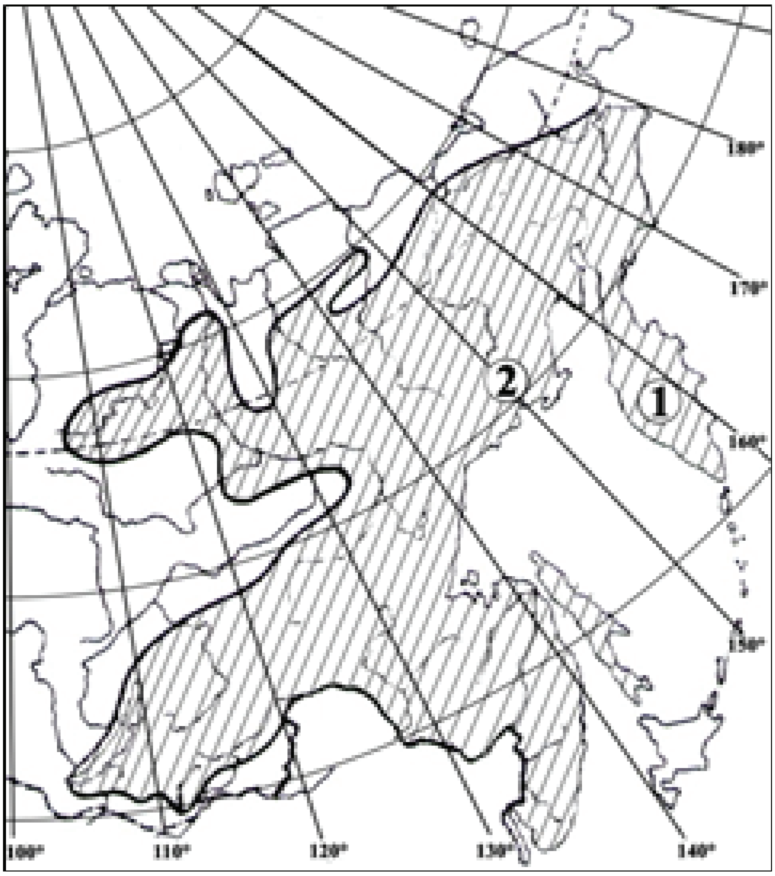

Figure 1: Distribution area of *Pinus pumila* in Russia [2] and the study area (1 – the Kamchatka Peninsula, 2 – the Magadan region).

The unique biology and ecology of dwarf Siberian pine [1] gives grounds to believe that his complex of wood-decaying Basidiomycetes also has some specific features. However, data on the wood-decaying fungi associated with this tree are very scarce [1, 4–6].

In this article, the original data on the biodiversity of wood-decaying Basidiomycetes in dwarf Siberian pine obtained during two international mycological expeditions in Northeastern Siberia (Magadan region) and the Kamchatka Peninsula in 1995 and 1997 are presented and discussed.

2. Methods

The climate in the Magadan region, located in the eastern part of Northeast Siberia (Figure 1), is distinctly continental (slightly less so in coastal areas), with average annual temperatures of −12.5°C and −5.8°C. The average annual rainfall is 275 (continental areas) to 330 mm (coastal areas). The permafrost has an annual average temperature of −0.6°C and the growing season is 99–109 d. Over 90% of the forest in the Magadan region is covered by *L. cajanderi*. The common component of the understory is *P. pumila*, which often forms pure thickets [7].

The Kamchatka Peninsula has a length from north to south of about 1100 km (51–60° N) and from west to east 450 km (156–163° E): in the west it is bordered by the Okhotsk Sea, in the east by the Bering Sea and the Pacific Ocean. The climate is moderately cold. In the central Kamchatka depression with coniferous forest, the annual precipitation is 600–800 mm, the sum of summer temperatures is 1400–1600°C and the growing season about 70 d. In the Kamchatka Peninsula, *P. pumila* occurs everywhere as pure thickets, in larch forests, of which it forms the upper border [1].

2.1. Sampling and identification

In each of the regions, route surveys were carried out in typical *P. pumila* habitats (Table 1). During route surveys, all the fungi growing on living or dead trunks of *P. pumila* were collected. The fungi were identified with the help of the following works: Ryvarden and Gilbertson [8, 9], Hansen and Knudsen [10] and Bernicchia and Gorjón [11]. The material is deposited in herbaria in Ekaterinburg (VAM), Copenhagen (C), Helsinki (H) or the reference herbarium of H. Kotiranta. Nomenclature follows *Index Fungorum* [12].

Table 1: List of surveyed localities with *P. pumila* in the Kamchatka Peninsula and Magadan region.

Area	Locality	Coordinates
Magadan region	Staritskogo Peninsula Magadan Sneznaya Valley Khapchagay Mountain Sinegorye Susuman Jagodnoe	59°30′ N 150°50′ E 59°34′ N 150°46′ E 59°43′ N 150°49′ E 61°92′ N 149°70′ E 62°09′ N 150°18′ E 62°52′ N 148°09′ E 62°55′ N 149°55′ E
Kamchatka Peninsula	Zhupanovo Tolbachik volcano Esso	54°32′ N 159°47′ E 55°49′ N 160°19′ E 55°55′ N, 158°41′ E

Source: Authors' own work.

The similarity of fungi species between the Magadan region and the Kamchatka Peninsula was evaluated with the Czekanowski-Sørensen ratio (1):

$$Kcs = 2J/A + B \quad (1)$$

where J is the number of species in common for the two lists, A is the number of species in the first list and B is the number of species in the second list. This ratio varies from 0 (no species in common) to 1 (all species in common).

3. Results

In total, 32 species of wood-decaying Basidiomycetes growing on dead and living trunks and branches of *P. pumila* were found: 16 in the Kamchatka Peninsula and 21 in the Magadan region. The comparison of the fungal complexes associated with *P. pumila* in the Magadan region and the Kamchatka Peninsula shows their significant differences. Of the 32 fungi species, only 5 (*G. sepiarium, P. pini, Ph. chrysoloma, S. lilacina* and *T. fuscoviolaceum*) occur on *P. pumila* in both regions, resulting in a low level of species similarity: Kcs = 0.27.

9 species of the fungi in the Kamchatka Peninsula and 19 in the Magadan region were described on *P. pumila* for the first time, a total of 27 species (Table 2). At the same time, we did not find the 19 species of the fungi described earlier on *P. pumila* in the Kamchatka Peninsula by Parmasto [4], Lyubarsky and Vasil'eva [5] and Khomentovsky [1]: *Amyloporia sinuosa* (Fr.) Rajchenb., Gorjón & Pildain, *Armillaria novae-zelandiae* (G. Stev.) Boesew, *Cinereomyces lindbladii* (Berk.) Jülich, *Inonotus cuticularis* (Bull) P. Karst., *Fomitopsis pinicola* (Sw.) P. Karst., *Gloeophyllum trabeum* (Pers.) Murrill, *Phaeolus schweinitzii* (Fr.) Pat., *Phanerochaete sordida* (P. Karst.) J. Erikss. & Ryvarden, *Porodaedalea pini* (Brot.) Murrill, *Postia sericeomollis* (Romell) Jülich, *P. undosa* (Peck) Jülich, *Rhodofomes cajanderi* (P. Karst.) B.K. Cui, M.L. Han and Y.C. Dai, *Scytinostroma odoratum* (Fr.) Donk, *Sidera lenis* (P. Karst.) Miettinen, *Skeletocutis amorpha* (Fr.) Kotl. & Pouzar, *S. uralensis* (Pilát) Kotl. & Pouzar, *Stereum hirsutum* Pers., *Trametes coccinea* (Fr.) Hai J. Li & S.Y. He and *Trichaptum abietinum* (Dicks.) Ryvarden. Some of the fungi were found in the area but on *Larix* (*F. pinicola, Ph. schweinitzii*) and *Betula* (*T. coccinea, S. hirsutum*). In our opinion, this indicates a strong temporal variation in the species composition of the fungi associated with *P. pumila.*

Table 2: Wood-decaying fungi associated with *Pinus pumila* in the Kamchatka Peninsula (1 – Esso, 2 – Tolbachik Volcano, 3 – Zhupanovo) and the Magadan region (1 – Jagodnoe, 2 – Khapchagay mountain, 3 – Magadan, 4 – Sinegorye, 5 – Sneznaya Valley, 6 – Staritskogo Peninsula, 7 – Susuman).

Species of Fungus	Kamchatka Peninsula Locality (Number of Findings)	Magadan region Locality (Number of Findings)
Alutaceodontia alutacea (Fr.) Hjortstam & Ryvarden	3* (1)	–
Antrodia serialis (Fr.) Donk	*Paja*	2* (1) *Lc*
Antrodia xantha	*Lc*	1* (1) *Lc*

Species of Fungus	Kamchatka Peninsula Locality (Number of Findings)	Magadan region Locality (Number of Findings)
Atheliachaete sanguinea (Fr.) Spirin & Zmitr.	1* (1)	*Lc*
Botryobasidium vagum (Berk & M. A. Curtis) D. P. Rogers	1 (1)	*Lc*
Ceriporia bresadolae (Bourdot & Galzin) Donk	–	1* (1)
Ceriporia purpurea (Fr.) Donk	*Chos*	1* (1) *Chos*
Chondrostereum purpureum (Pers.) Pouzar	*Ber*	5* (1) *Ber, Chos, Dusch, Sal, Psua*
Coniophora arida (Fr.) P. Karst.		1* (1)
C. olivacea (Fr.) P. Karst.	1 (1) *Lc, Abs*	*Lc*
C. puteana (Schumach.) P. Karst.	*Ber, Abs*	5* (1)
Crepidotus caspari Velen. Saz	1* (1)	
Dichomitus squalens (P. Karst.) D. A. Reid	*Paja*	1* (1) *Lc*
Flaviporus cf. *citrinellus* (Niemelä & Ryvarden) Ginns	–	3* (1)
Gloiothele citrine (Pers.) Ginns & G. W. Freeman	3* (2) *Ber, Abs*	–
Gloeophyllum sepiarium (Wulfen) P. Karst.	1, 2 (5) *Lc, Paja*	5* (2) *Lc*
Irpicodon pendulus (Alb. & Schwein.) Pouzar	–	6* (1)
Leptosporomyces septentrionalis (J. Erikss.) Krieglst.	3* (1) *Abs*	–
Neolentinus lepideus (Fr.) Redhead & Ginns	–	1* (1) *Lc*
Peniophora pini (Schleich.) Boidin	1, 2 (3)	1 (1)
Phellinus chrysoloma (Fr.) Donk	1, 2 (3) *Abs, Paja*	4* (1) *Lc*
Postia caesia (Schrad.) P. Karst.	*Abs, Paja*	5* (1) *Lc*
P. hibernica (Berk. & Broome) Jülich	3* (1)	–
Rhizochaete violascens (Fr.) K. H. Larss.	–	5* (2)
Skeletocutis lilacina A. David & Jean Keller	1, 2, 3* (7)	5* (2)
Stereum sanguinolentum (Alb. & Schwein.) Fr.	*Lc, Pjez, Abs*	5, 6* (3) *Lc*
Trichaptum fuscoviolaceum (Ehrenb.) Ryvarden	1, 2 (4) *Lc, Paja*	1, 5 (3) *Lc*
Tubulicrinis angustus (D.P. Rogers & Weresub) Donk	–	7* (1)
T. glebulosus (Fr.) Donk	*Ber, Abs*	5* (2) *Lc*
Vararia investiens (Schwein.) P. Karst.	1 (1) *Lc, Ber*	–
Xenasmatella vaga (Fr.) Stalpers	1, 2, 3* (3) *Dusch, Abs*	–
Xylodon asperus (Fr.) Hjortstam & Ryvarden	3* (3)	–

Source: Authors' own work.

Note: * – species described on *P. pumila* for the first time; italics – trees on which the fungus is found in the research area in addition to *P. pumila*: *Abs* – *Abies sachalinensis* Fr. Schmidt; *Ber* – *Betula ermanii* Cham.; *Chos* – *Chosenia arbutifolia* (Pall.) A. Skvorts., *Dusch* – *Duschekia fruticosa* (Rupr.) Pouzar; *Paja* – *Picea ajanensis* (Lindl. et Gord) Fisch. ex Carr.; *Psua* – *Populus suaveolens* Fisch.; Sal – *Salix* sp.; – the species was not found.

Fungi associated with *P. pumila* can be divided in two groups. The first include the main part of species met in the study area on both *P. pumila* and other trees: 12

species were noted on coniferous trees, 6 on both coniferous and deciduous and 2 on deciduous (Table 2). In this group, we should include *C. arida*, *X. asperus*, occurring in the Kamchatka Peninsula on *B. ermanii*, [4] and *C. caspari*, met on *C. arbutifolia* and *Salix* sp. in the Magadan region [6]. Thus, this group includes 23 species, or 72% of the fungi associated with *P. pumila*.

The fungi of the second group (9 species) in the study area are restricted to *P. pumila* as the host: 4 species (*A. alutacea, P. pini, P. hibernica, S. lilacina*) in Kamchatka and 7 species (*C. bresadolae, F.* cf. *citrinellus, I. pendulus, P. pini, R. violascens, S. lilacina, T. angustus*) in the Magadan region. With the exception of *P. pini* and *S. lilacina*, they are noted on *P. pumila* as single findings: it is highly likely that their absence is random and their substrate spectra will be expanded upon further study. In favor of this is the fact that in other parts of their distribution they occur on different species of coniferous (*A. alutacea, F. cf. citrinellus, I. pendulus, P. pini, P. hibernica, S. lilacina*) or coniferous and deciduous (*C. bresadolae, R. violascens, T. angustus*) trees [8–11].

For example, *S. lilacina* (Figure 2) – the most common species on *P. pumila* – was first described in 1984 in a mountain locality in Switzerland on *Picea* [13]: only slowly has it been found in other areas. Niemelä and Day [14] found it in Hudson Bay in Canada, Ryvarden et al. [15] reported two collections from Norway between 60° and 66° N and in Finland it has been found in most of the country (between 61° and 68° N) [16]: recently, two records were found in northernmost Sweden, at 67° N [17]. All European and Canadian records were found on *Picea*. *S. lilacina* is also found on this tree in the Urals [18]. The westernmost location of this species in *P. pumila* was in Buryatia, in the vicinity of Lake Baikal (53°83′ N 109°05′ E). In this part of Siberia *S. lilacina*, occurs on *Larix sibirica* Ledeb, in addition to *P. pumila*. [19]. In our data, it also occurs on *L. gmelinii* (Rupr.) Rupr. in Sakha (62°2′ N 129°38′ E), the western border of the range of *P. pumila*.

As in the Kamchatka Peninsula and Magadan region, the fungi on *P. pumila* are typically very few in number, with many being recorded in single records in a few localities: 63% species in the Kamchatka Peninsula and 90% species in the Magadan region were found in one locality as a single find. From 32 species, only 5 in our collections are represented by 3–7 samples: *G. sepiarium, S. lilacina* and *T. fuscoviolaceum* in the Kamchatka and *S. sanquinolentum* and *T. fuscoviolaceum* in the Magadan region (Table 2). In total, during two field sessions wood-decaying fungi were found on *P. pumila* 67 times: 39 in Kamchatka and 28 in the Magadan region.

In Kamchatka, the greatest diversity of fungi is noted in the area of the village of Esso: 11 species. In the vicinity of the volcano Tolbachinsky and the village Zhupanovo, 6–7 species were found. Only 2 species – *S. lilacina* and *X. vaga* – were found in all

Figure 2: *Skeletocutis lilacina*. P. Corfixen 97.159; photo by H. Knudsen.

three localities. The same situation occurs in the Magadan region, where the greatest diversity of fungi on *P. pumila* was found in the vicinity of the village of Yagodnoe (8 species) and in the Snowy Valley (9 species): only *T. fuscoviolaceum* is present in both localities (Table 2).

4. Conclusion

Overall, 32 species of wood-decaying Basidiomycetes were described for dwarf Siberian pine in the Magadan region and Kamchatka Peninsula, 27 for the first time: 19 in the first region and 9 in the second. Communities of wood-decaying fungi associated with this tree have a low biodiversity and consist of 16 species in Kamchatka and 21 species in the Magadan region, with only 5 of them being common to both areas. All fungi are widespread species: 23 of them occur not only on this tree, but also in others. 9 species were noted only for *P. pumila*, but they are not specific to this tree because in other regions they are found on different plant species. The important feature of the fungi associated with the dwarf Siberian pine is their extremely low number and the strong temporal and habitat variation of species composition, which shows that this tree does not have its own specialized and stable complex of wood-decaying Basidiomycetes. Schmid-Heckel [20, P. 11] came to the same conclusion when he compared the fungi on *Pinus cembra* L. in the German part of the Alps with other trees: 'All species found on the wood of *P. cembra* also occurred on other conifers and deciduous trees'. Although this study was based on far fewer species, the conclusion was the same.

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