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The Meruliaceae of Russia. II. *Panus*

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Summary. The history of taxonomical study of the genus *Panus* Fr. (Meruliaceae, Polyporales, Basidiomycota) is considered. A current revision of the genus in Russia was carried out. Two species of the genus *Panus* were recorded in various regions of Russia, *Panus conchatus* (Bull.) Fr. and *P. lecomtei* (Fr.) Corner. For *P. conchatus*, the lateral ecotype with conchiform pileus and rather dark wine-red to lilac-brown surface is more characteristic. Two main deviations from such a neutral type were described: 1) the chromatic one, characterized by light-colored (red or clay-yellow), usually conchiform pilei [*P. conchatus* var. *inconstans* (Pers.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko] and 2) the growth one, characterized by a central (often bulbous) stipe, funnel-shaped cap and strongly inrolled margin [*P. conchatus* var. *torulosus* (Pers.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko]. For *P. lecomtei*, the ecotype having small eccentric to lateral elegant stipe is considered. However, the stipe shape and size are variable. The stipe can be either central – rather small, with a bulbous base [*P. lecomtei* var. *semirudis* (Singer) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko], or strongly elongated [*P. lecomtei* var. *stipitata* (Malk.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko]. Four new combinations, *P. conchatus* var. *inconstans*, *P. conchatus* var. *torulosus*, *P. lecomtei* var. *semirudis*, and *P. lecomtei* var. *stipitata* were suggested. It was concluded that *Panus* represents rather well-delimited genus belonging to merulioid phylogenetic radiation, whose morphotype on essential features of its organization is trametoid, but superficial habitual features make it closer to the lentinoid one. Its essential features are the abundance of fibrohyphae which form *textura intricata*, slowly growing basidiocarps and strictly lamellate hymenophore. Apparently, such an adaptive structure was generated at arid and warm climatic zones, and only 2 species, *P. conchatus*, and *P. lecomtei*, have been irradiated into temperate latitudes. The substrate spectrum of these fungi is determined by their insensitivity to substrate moistening and best ability to colonize hardwood, so the greatest number of their finds can be made on stumps and large remnants of stand-formers of corresponding forest areas. In Russia, a reliable association of *Panus* species to *Betula* spp. and *Populus* spp. was revealed. An ecotypic differentiation of the genus *Panus* is related to the quality of substrate colonized. The basidiocarps, growing over top cuts of the stumps, are characterized by strong central stipe (*P. conchatus* var. *torulosus*, *P. lecomtei* var. *semirudis*), whereas basidiocarps with sublateral attachment are common on fallen logs. Certain chromatic adaptations (*P. conchatus* var. *inconstans*) are associated with an insolation regime of the habitat. During last years, the *Panus* representatives have attracted an interest in biomedical research development. Their resource potential estimation should proceed from the fact that within Russian territory, such areas as Middle Belt of European Russia, North Caucasus, Altai and other regions of Southern Siberia are promising for replenishing the strains of *P. conchatus* and *P. lecomtei*.

Мерулиевые грибы России. II. Род *Panus*

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Аннотация. Рассмотрены этапы таксономического изучения рода *Panus* Fr. (Meruliaceae, Polyporales, Basidiomycota). Проведена ревизия видов, известных для России. Изучены материалы Гербариев Ботанического института им. В. Л. Комарова (LE) и Пермского государственного национального исследовательского университета (PERM). Впервые обобщены литературные и гербарные данные о внутривидовом полиморфизме бореальных таксонов рода. Согласно имеющимся гербарным и литературным данным, на территории России зафиксировано 2 вида рода *Panus* – *Panus conchatus* (Bull.) Fr. и *P. lecomtei* (Fr.) Corner. Для *P. conchatus* наиболее характерен латеральный экотип с раковинообразной шляпкой и довольно темной лилово-коричневой поверхностью. Были описаны два основных отклонения от такого модального типа: 1) хроматическое, характеризующееся светло-красными (красными или глиняно-желтыми) шляпками [*P. conchatus* var. *inconstans* (Pers.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko] и 2) ростовое, характеризующееся центральной (часто бульбовидно вздутой) ножкой, воронковидной шляпкой и сильно подогнутым краем [*P. conchatus* var. *torulosus* (Pers.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko]. Для *P. lecomtei* наиболее характерным экотипом является латеральный, с небольшой ножкой. Встречаются экотипы со вздутой центральной [*P. lecomtei* var. *semirudis* (Singer) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko], либо сильно удлиненной латеральной ножкой (*P. lecomtei* var. *stipitata*). Для перечисленных разновидностей было предложено 4 новые комбинации [*P. conchatus* var. *inconstans*, *P. conchatus* var. *torulosus*, *P. lecomtei* var. *semirudis*, *P. lecomtei* var. *stipitata* Malk.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko]. Проведенные исследования позволяют характеризовать *Panus* как хорошо ограниченный род, относящийся к мерулиоидной филогенетической радиации, морфотип которого в основе траметоидный, но несущий поверхностные черты лентиноидных грибов. Его существенными особенностями являются обилие фиброгиф, образующих «перепутанную текстуру» ткани, медленно растущие базидиомы и строго пластинчатый гименофор. По-видимому, такая адаптивная структура была выработана изначально в условиях теплого засушливого климата, и лишь 2 вида (*P. conchatus* и *P. lecomtei*) позднее приспособились к обитанию в умеренных широтах. Субстратный спектр этих грибов определяется их нечувствительностью к обводненности субстрата и лучшей способностью к колонизации древесины лиственных пород, поэтому наибольшее количество их находок можно сделать на пнях и крупных остатках основных лесообразующих пород лесов умеренных и теплых широт. Гербарный материал с территории России собран с пней и валежной древесины из родов *Betula* и *Populus*. Экотипическая дифференциация рода *Panus* связана с особенностями колонизированного субстрата. Базидиомы, появляющиеся сверху пней, характеризуются обычно крепкой центральной ножкой (*P. conchatus* var. *torulosus*, *P. lecomtei* var. *semirudis*), в то время как на боковых поверхностях валежных стволов развиваются латерально прикрепленные экотипы со слабо развитой ножкой. Оценка ресурсного потенциала представителей этого рода в пределах России должна исходить из наибольшей распространенности *P. conchatus* и *P. lecomtei* в Средней полосе России, на Северном Кавказе, Алтае и других районах Южной Сибири, где имеет смысл организовать работы по пополнению штаммового разнообразия этих видов.

Introduction

This paper continues a taxonomical survey on the genera of Meruliaceae (Polyporales, Basidiomycota) presented in Russian mycobiota (Zmitrovich et al., 2016), and it is devoted to an interesting genus *Panus* Fr., for a long time considering first within Pleurotaceae, later within Polyporaceae families, but in fact being closely related to the genera *Cerrena* Gray and *Steccherinum* Gray of merulioid phylogenetic radiation.

The genus *Panus* was described by Fries in «Epicrisis Systematis Mycologici seu Synopsis Hymenomycetum» (Fries, 1838) where it was characterized as follows: «*Totus fungus carnoso-coriaceus*, *tenax*, *arescens*, *contexto fibroso*. *Lamellae perfectae*, *tenaces*, *firmae*, *inaequales*, *acie acuta integerrima*, *saepe venoso-connexae; trama distincta*, *fibrosa in hymenium radians*. *Sporidia alba*. *Fungi epixyli*, *difformes laterales*, *diu persistens*». From previously described genus *Lentinus* Fr. (Fries, 1825) the genus *Panus* was differentiated by Fries in the following way: «*A Lentinis genuinis*, *quales omnes Europaei*, *lamellis tenacibus et acie integerrima mox dignoscitur*». Hereby, an entire gills edge in *Panus* representatives was established as the basic discriminant character of two genera by Fries. In total, 17 species have been distinguished by Fries in the genus *Panus*, while some of which cannot be correlated with existing herbarium material (below such species will be marked with an interrogation point): *Panus farneus* Fr. (?), *P. cyatniformis* (Schaeff.) Fr. [= *Neolentinus cyatniformis* (Schaeff.) Della Mag. et Trassin.], *P. pycnoticus* (Klotzsch) Fr. (?), *P. torulosus* (Pers.) Fr. [= *P. conchatus* (Bull.) Fr.], *P. rudis* Fr. [= *P. lecomtei* (Fr.) Corner], *P. velutinus* (Fr.) Sacc., *P. hirtus* Fr. (?), *P. foetens* Fr. (?), *P. dorsalis* (Bosc.) Fr. (?), *P. stipticus* (Bull.) Fr. [= *Panellus stipticus* (Bull.) P. Karst.], *P. farinaceus* (Schumach.) Fr. (= *Panellus stipticus*), *P. lunatus* Fr. (?), *P. copulatus* (Ehrenb.) Fr. [= *Lentinus copulatus* (Ehrenb.) Henn.], *P. patellaris* Fr. [= *Tectella patellaris* (Fr.) Murrill], *P. delastri* Fr. (?), *P. lithophilus* Fr. (?). Subsequently, the character of gills edge for differentiation *Panus* from *Lentinus* was adopted by many agaricologists.

An important episode in *Panus* taxonomy is related to the works by Singer. In 1951, on the basis of complex similarities between *Lentinus*, *Panus*, and *Polyporus* Fr., this mycologist has united three genera with such genera as *Pseudovafolus* Pat., *Mycobonia* Pat., *Phyllotopsis* E.-J. Gilbert et Donk ex Singer, and *Pleurotus* (Fr.) P. Kumm. in the family Polyporaceae (Singer, 1951). Considering the *Lentinus lepideus* (Fr.: Fr.) Fr. as type species for *Lentinus* (the more correct modern typification is *L. crinitus* L.), Singer unites all the small-spored species within the genus *Panus*. Thereafter he has reissued this system three times without essential changing of the concept (Singer, 1962, 1975, 1986).

Corner (1981) has differentiated the genera *Lentinus* and *Panus* on the basis of the branching pattern of skeletal hyphae which are organized as dendrites with an inflated axial element in *Lentinus* and stay unbranched in *Panus*. In 1983, Pegler has published a monograph on the genus *Lentinus*, which includes according to this author the *Panus*-union as a subgenus, but basing on Corner's principles. Within the *Lentinus* subgenus there are considered species with branched and swollen sclerohyphae, whereas the *Panus* subgenus unites the species with fibrohyphae (Pegler, 1983).

In the period of molecular taxonomy (Ko, Jung, 1999; Grand, 2004; Larsson, 2007; Lee, Lim, 2010; Miettinen, Larsson, 2011; Zmitrovich, Malysheva, 2013) it was shown that the genus *Panus* sensu Corner is substantially distant from *Lentinus* (core Polyporaceae), but closely related to the genus *Cerrena* Gray (large merulioid phylogenetic radiation). Within the framework of "splitter's approach", even two closely related families – Cerrenaceae and Panaceae – have been described (Justo et al., 2017), although we believe that the preservation of the "large Meruliaceae" lies in canvas of more balanced classification of the Polyporales.

Distracting from macromorphology, it can be seen that *Cerrena* and *Panus* have much in common: e. g. unbranched fibrohyphae, highly characteristic sclerified elements protruding the hymenium, traditionally called as sclerocystidia or metuloids in the genus *Panus*, and as pseudocystidia in the genus *Cerrena*, finally, rather similar basidia and basidiospores. It should be emphasized the absence of any inflated hyphal elements (characteristic feature of representatives of *Lentinus* and *Polyporus* s. l.) in all tissues of representatives of the genus *Panus*. This feature, as well as rather slow growth of the basidiomata with the formation of solid and often twisting stipe of *textura intricata*, allows to interpret *Panus*-like morphotype consider only superficially similar to lentinoid one. It is rather a unique adaptive structure combining true lamellate hymenophore and trametoid growth and tissues organization. Studies on hymenophore development in *Panus conchatus*, *P. lecomtei*, and *P. fulvus* (Hibbett et al., 1993) also confirm this conclusion.

The aim of the present paper is detailed characterization of the genus *Panus* in Russia, including a modern morphological elaboration, survey of intraspecies polymorphism, substrate preferences and resource potential, considering that some species of this genus are known as promising subject for biomedical research, since produce panepoxidone and isopanepoxidone, substances that has an inhibitory effect on a number of inflammatory chemokines secreted by cancer tissues (Erkel et al., 1996; Shotwell et al., 2000).

Materials and Methods

The macroscopic descriptions were based on a study of fresh and dried specimens. The materials of the herbaria of Komarov Botanical Institute (St. Petersburg, LE) and Perm State National Research University (PERM) were studied. Microscopic preparations were mounted from dried material in Melzer's solution, 10 % ammoniacal Congo Red and 5 % aqueous solution of KOH, using a LOMO Micmed-6 light microscope. The hyphal system was revealed and described according to updated technique (Zmitrovich et al., 2009). The size of mature spores was measured on 30 spores in distilled water and Melzer's solution.

Results and Discussion

Meruliaceae Rea, 1922, British Basid.: 620.

= Podoscyphaceae D. A. Reid, 1965, Beih. Nova Hedwigia 18: 43.

= Steccherinaceae Parmasto, 1968, Consp. syst. Cort.: 169.

= Bjerkanderaceae Jülich, 1982, Bibl. Mycol. 85: 356.

= Hapalopilaceae Jülich, 1982, Bibl. Mycol. 85: 370.

= Hyphodermataceae Jülich, 1982, Bibl. Mycol. 85: 373.

= Mycorrhaphiaceae Jülich, 1982, Bibl. Mycol. 85: 380.

= Phanerochaetaceae Jülich, 1982, Bibl. Mycol. 85: 384.

= Phlebiaceae Jülich, 1982, Bibl. Mycol. 85: 385; Boidin, Mugnier et Canales, Mycotaxon 66: 486, 1998 illeg.

= Irpicaceae Spirin et Zmitr., 2003, Mycena 3: 48.

= Cerrenaceae Miettinen, Justo et Hibbett, 2017, Fungal Biol. 121: 817.

= Panaceae Miettinen, Justo et Hibbett, 2017, Fungal Biol. 121: 817.

Steccherinoideae Parmasto, 1968, Consp. syst. Cort.: 172.

Panus Fr., 1838, Epicr. Syst. Mycol.: 396–397. Nomen conservandum.

= *Lentinopanus* (Pilát) Pilát, 1941, Ann. Mycol. 39: 72 (type *Agaricus conchatus* Bull. : Fr.).

Basidiocarp solitary or caespitose, medium-sized to large, slowly growing, tough and persistant, originating from a woody substratum or from sclerotium, of lentioid habitus with gymnocarpic development. Pileus convex, then depressed to umbilicate, tough with dry, with hirsute, fibrillose-squamulose, squamose, or glabrous surface. Margin mostly inrolled, even, or radially ribbed. Hymenophore lamellate. Gills of 2–4 levels, decurrent, rarely furcate, moderately spaced to densely crowded; edge entire. Stipe central to lateral and very reduced, stiff, solid, continuous with the pileus. Context fibrous, tough-fleshy to coriaceous, mostly thin. Spore print white to cream colour.

Hyphal system dimitic with unbranched fibrohyphae. Skeletal hyphae (fibrohyphae) predominates in mature basidiocarps, thick-walled, hyaline or yellowish. Generative hyphae thin- to moderately thick-walled, with clamp connections, hyaline. Pileipellis as a repent epicutis of radially parallel hyphae or collapsing trichoderm. Hymenophoral trama irregular, of *textura intricata*, with sometimes thickening hymenium. Gills-edge usually sterile; as a rule, with emergent pseudocystidia (cheilocystidia). Pleurocystidia absent or present pseudocystidia. Basidia clavate with medial constriction, 4-spored, with a basal clamp. Basidiospores cylindric, or ellipsoid-cylindric to ovoid, hyaline, thin-walled, smooth, lacking both a perisporium and a germpore, inamyloid, acyanophilous.

On dying and dry trees, fallen logs, stumps and large fallen branches of trees and shrubs, presumable angiosprems. Causes a white rot. Worldwide, more abundant in the tropics.

Type species: *Agaricus torulosus* Pers., 1801, Syn. meth. fung. 2: 475 : Fr., 1821, Syst. Mycol. 1: 181 = *A. conchatus* Bull., 1787, Herb. Fr. 7: tab. 298 : Fr., 1821, Syst. Mycol. 1: 181 (selected in Greuter et al. 2000).

Type specimen is deposited in Friesian herbarium of the Uppsala University Museum of Evolution (UPS) (Ryvarden, 1991).

Differential generic suggestions. The genus *Lentinus* Fr. has a superficial resemblance, but differs by skeleto-binding hyphae with inflated axial segment (all the *Panus* representatives have uninflated skeletals). The genus *Lignomyces* R. H. Petersen et Zmitr. is superficially similar too, but differs by monomitic hyphal system with strongly inflated hyphal segments and a dorsal stem attachment (Petersen et al., 2015). Phylogenetically related genus *Cymatoderma* Jungh. differs by podoscyphoid habitus and the presence of ventricose hymenial gloeocystidia. Phylogenetically related genus *Cerrena* differs by daedaleoid/trametoid habitus and less elongated (in median) basidiospores.

Ecology and substrata. All the *Panus* representatives are rather thermophilic, xerotolerant and non-sensitive to substrate watercut, why they are especially often found on large logs and stumps, without allocation of strict substrate specificity. On the other hand, they have not very high enzymatic activity and are generally not adapted to deep decomposition of coniferous wood. This circumstance, as well as their attraction to large-scale tree residues, are the reasons that in zonal biomes they are most often associated to deciduous stand formers (mostly *Betula* and *Populus* in the temperate-boreal zone, and *Quercus* and *Fagus* in the nemoral zone), although they readily colonize many other trees.

Type of rot. All the *Panus* representatives cause a white rot. Oxidative enzymes were carefully investigated in *Panus lecomtei* and *P. conchatus* (Zhang et al., 2006; Zhou et al., 2014). It was shown that purified enzymes of these fungi belong to the laccases family, due to the following observations: 1) the enzyme exhibited a broad substrate pattern, 2) oxygen was used as an oxidative agent, while there was no H_2O_2 to initiate the catalytic oxidation, and 3) the determined N-terminal primary structure of the enzyme exhibited a high degree of similarity with the corresponding laccases sequences.

Secondary metabolites and perspectives in biomedical research. A metabolite of great application value, panepoxidone has been detected in *P. lecomtei* by Erkel group (Erkel et al., 1996). Such metabolite as isopanepoxidone has been isolated from *P. conchatus* by Shotwell et al. (2000), and this substance has a similar effect reducible to the prevention of degradation of inhibiting particles of NF-κB (IκBα) that inactivate this transcriptional factor. NF-κB chemokine represents the main pro-inflammatory factor, constitutionally associated with cancer progression (Zmitrovich, 2015), therefore such substance as panepoxidone is a prospective subject for biomedical research, whereas the *Panus* species have a great resource value.

Also, it should be mentioned the production of pink-lilac pigment complexes by both tropical and temperate *Panus* representatives which were noted already by Miller (1967), but yet were not chemically fractioned.

Specifics of *Panus*-like morphotype. Basidiocarp development in the *Panus* representatives was studied by Hibbett et al. (1993), whereas their hyphal differentiation was studied by Zmitrovich et al. (2009). As it was shown, the hymenophore differentiation in *Panus* involves the periclinal growth of context hyphae below a closed surface palisade of hymenial elements, resulting in a cantharelloid appearance and radiate trama. This pattern is qualitatively different from that in *Lentinus* s. str., which suggests that lamellae of *Panus* and *Lentinus* are not homologous. *P. conchatus* and *P. lecomtei* basidiocarps have short stipes, whereas *P. fulvus* basidiocarps have an elongate stipe, and develop from a pseudosclerotium. *P. conchatus* sporocarps developed an ephemeral partial veil that was obliterated during basidiocarp expansion, whereas primordia of *P. lecomtei* are initially gymnocarpic. Analysis of hyphal system of all the tropical representatives of the genus indicates the rigorous dimitism of mature basidiocarp, whereas in *P. conchatus* and *P. lecomtei* the hyphae sclerify slower, while mature basidiocarps include the hyphal elements on different stages of maturation (Zmitrovich et al., 2009). The absence of physalohyphae determining the accelerated growth of agaricoid basidiocarps makes the growth of *Panus* representatives more monotonous and slow, what, in combination with its hyphal structure, brings *Panus*-like morphotype together with trametoid one. However, the hymenophore of *Panus* is a classical lamellate that indicates a surprising convergence among agaricomycetes.

Tropical species. As a rather specific adaptive type, the genus *Panus* was generated by arid and warm climates of the planet, where the main species diversity of the genus is concentrated. The following species, common in various tropical regions, are most known.

Panus ciliatus (Lév.) T. W. May et A. E. Wood, 1995, Mycotaxon 54: 148 (Bas.: *Lentinus ciliatus* Lév., 1844; Syn.: *L. melanophyllus* Lév., 1844; *L. setiger* Lév., 1844; *L. echinopus* Lév., 1846; *L. braccatus* Lév. in Zolling., 1854; *L. dichrous* Lév. In Zolling., 1854; *L. zonifer* Berk. et Broome, 1873; *L. egregious* Massee, 1910; *Panus brunneipes* Corner, 1981).

P. fasciatus (Berk.) Singer, 1962, Agaricales mod. Tax. 2nd ed.: 172 (Bas.: *Lentinus fasciatus* Berk., 1840; Syn.: *L. dealbatus* Fr. in Lehmann, 1847; *L. fuscopurpureus* Kalchbr., 1880; *L. holopogonius* Berk. ex Cooke, 1892; *L. terrestris* Lloyd, 1925).

P. hookerianus (Berk.) T. W. May et A. E. Wood, 1995, Mycotaxon 54: 148 (Bas.: *Lentinus hookerianus* Berk., 1851).

P. similis (Berk. et Broome) T. W. May et A. E. Wood, 1995, Mycotaxon 54: 148 (Bas.: *Lentinus similis* Berk. et Broome, 1873; Syn.: *L. velulinus* Fr. var. *africanus* P. Henn. in Engler, 1893; *L. erringtohnii* Pat., 1900; *L. samurensis* Pilát, 1941).

P. strigellus (Berk.) Chardon et Toro, 1934, Monogr. Univ. Porto Rico Ser. B 2: 315 (Bas.: *Lentinus strigellus* Berk., 1868; Syn.: *Panus guaraniticus* Speg., 1883; *Lentinus crispus* Pat., 1889; *L. tubarius* Pat., 1899; *Pocillaria palmeri* Earle, 1906; *Lentinus subglaber* Lloyd, 1917).

P. tephroleucus (Mont.) T. W. May et A. E. Wood, 1995, Mycotaxon 54: 148 (Bas.: *Lentinus tephroleucus* Mont., 1851; Syn.: *L. leprieurii* Mont., 1854; *L. siparius* Berk. et M. A. Curtis, 1868; *L. dentatus* Bres., 1925).

P. velutinus (Fr.) Overh., 1930, J. Dept Agric. Porto Rico 14: 353 non Fr., 1838 (Bas.: *Lentinus velutinus* Fr., 1830; Syn.: *Lentinus fulvus* Berk., 1842; *L. coelopus* Lév., 1846; *L. nepalensis* Berk., 1854; *L. blepharodes* Berk. et M. A. Curtis, 1868; *L. fastuosus* Kalchbr. et MacOwan, 1881; *L. fallax* Speg., 1883; *L. castaneus* Ellis et Macbr., 1896; *L. holumbrinus* De Seynes, 1897; *L. fissus* P. Henn., 1897; *L. natalensis* Van der Byl., 1924; *L. thomensis* Coutinho, 1925; *L. pseudociliatus* Raithelhuber, 1974).

Provisional position: *Lentinus hirtiformis* Murrill, N. Am. Fl. 9: 293, 1915; *L. courtetianus* Har. et Pat., Bull. Mus. Hist. Nat. Paris 15: 88, 1909 (Zmitrovich, Malysheva, 2013).

Species irradiating into temperate zones. Two species, being widespread in subtropical and tropical regions, have been irradiated into temperate zones of the northern and partly southern hemispheres. They are characterized by less xeromorphic habitus in comparison to strictly tropical species and demonstrate pseudodimiticism even at rather advanced developmental stages. Both species are distributed throughout Russia: *P. conchatus* and *P. lecomtei* (see below).

Key to temperate species

1. Upperside matt-subtomentose, soon glabrescent and cracking with formation of fine appressed squamules; basidia 20–35 × 4.5–6 µm; basidiospores 5–6.5 × 2.2–3.5 µm, ellipsoid-cylindrical .... 1. ***P. conchatus***

– Upperside tomentose, then strigose; basidia 15–20 × 3.5–5 µm; basidiospores 4.5–6 × 2.5–3.7 µm, mostly ovoid .... 2. ***P. lecomtei***

1. ***Panus conchatus*** (Bull.) Fr., 1838, Epicr. Syst. Mycol.: 396.

≡ *Agaricus conchatus* Bull., 1787, Herb. Fr. 7: tab. 298 : Fr., 1821, Syst. Mycol. 1: 181.

= *A. carneotomentosus* L., 1753, Sp. pl. 2: 1171.

= *A. flabelliformis* Schaeff., 1774, Fung. bavar. palat. nasc. 4: 20.

= *A. carneotomentosus* Batsch, 1783, Elench. fung.: 89.

= *A. mesentericus* Batsch, 1783, Elench. fung. (Halle): 91.

= *A. carnosus* Bolton, 1792, Hist. fung. Halifax, App. 3: 146.

= *A. flabellatus* J. F. Gmel., 1792, Syst. Nat. 2(2): 1410.

= *A. inconstans* Pers., 1800, Comm. Schaeff. Icon. Pict.: 17.

= *A. fornicatus* Pers., 1801, Syn. meth. fung. 2: 475.

= *A. torulosus* Pers., 1801, Syn. meth. fung. 2: 475.

= *Pleuropus fornicatus* Gray, 1821, Nat. Arr. Brit. Pl. 1: 615.

= *Panus monticola* Berk., 1851, Hooker's J. Bot. Kew Gard. Misc. 3: 46.

= *P. vaporarius* Bagl., 1865, Comm. Soc. crittog. Ital. 2(fasc. 2): 264.

= *Lentinus percomis* Berk. et Broome, 1875, J. Linn. Soc., Bot. 14(no. 73): 42.

= *L. bresadolae* Schulzer, 1885, Hedwigia 24(4): 141.

= *Panus flabelliformis* Quél., 1888, Fl. Mycol. France (Paris): 325.

= *Lentinus obconicus* Peck, 1906, Bull. Torrey bot. Club 33(4): 215.

Icon.: Malkovský (1932: fig. 1–4, ut *Panus flabelliformis*); Phillips (1981: fig. 267d); Pegler (1983: fig. 35); Hansen, Knudsen (1992: fig. 2 ut *Lentinus conchatus*); Courtecuisse, Duhem (1994: fig. 135); Zmitrovich et al. (2004: fig. 25); Knudsen, Vesterholt (2008: 73D).

Basidiocarp solitary or caespitose, medium-sized, originating from a woody substratum, of lentioid habitus. Pileus 1.5–15 cm diam., tough fleshy, then coriaceous, applanate or depressed, often conchoid or cyathiform. Upperside pinkish-lilac to vinaceous-purple when young, then fading from the centre to pale-clay, ochraceous-brown or cinnamon, matt-subtomentose, soon glabrescent, finally smooth and shiny or cracking at the centre to form indefinite, appressed squamules. Margin sharp, thin, inrolling, slightly undulate or lobed, pruinose when young, occasionally strigose. Stipe central to lateral, 0.5–4 × 0.5–3 cm, cylindric to bulbous, sometimes tapering at the base, solid; surface initially tinted violaceous then fading to leave a pale grey, velutinate to short strigose tomentum, pubescent at the base, finally glabrous. Context tough fleshy, then coriaceous, 1–15 mm thick at the disk, ivory-white. Hymenophore lamellate. Gills deeply decurrent with a ridge extending down the stipe, often slightly anastomosing over the stipe surface, at first violaceous or purplish then cream colour, pinkish towards the edge; initially very narrow but eventually becoming broader, 2–4.5 mm wide, very crowded, with lamellulae of four lengths; edge entire (Fig. 1).

Hyphal system dimitic with rather prolonged pseudodimitic stage. Generative hyphae 2–4.5 µm diam., non-inflating, hyaline, thin-walled, branched, with large clamp connections. Skeletal hyphae 2–5 µm diam., unbranched, sinuose, hyaline, thick-walled, the pseudoskeletal hyphae of the same diameter, with clamp connections, and refractive contents predominate in young basidiocarps. Pileipellis an epicutis, 45–90 µm thick, of repent, radially parallel generative hyphae 3–5 µm diam. with a golden-brown wall. Hymenophoral trama irregular, hyaline, of radiate construction, similar in structure to the context. Gills-edge sterile, with conspicuous, crowded, clavate to sublageniform cheilocystidia 24–60 × 7–16 µm, hyaline, thin- to thick-walled. Pleurocystidia (pseudocystidia) abundant, 25–70 × 5–10(12) µm, narrowly clavate, often sinuous and constricted, thick-walled, originating deep in the subhymenial layer and projecting 5–20 µm above the basidia. Basidia 20–35 × 4.5–6 µm, clavate-cylindrical, 4-spored, with a basal clamp. Basidiospores 5–6.5 × 2.2–3.5 µm, ellipsoid-cylindrical, hyaline with few contents, thin-walled.

On dying trees, fallen logs and branches, stumps of many hardwoods, causing a white rot.

Substrata: on many hardwoods, especially *Betula* spp. and *Populus tremula*, rarely on conifers (*Pinus sylvestris*).

Cultural characteristics: Hibbett et al. (1993); Johnson, Methven (1994); Grand (2004).

General distribution: EUROPE (Austria, Belarus, Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Latvia, Lithuania, Norway, Russia, Scotland, Spain, Sweden, Ukraine); AFRICA (Ethiopia); ASIA (Armenia, Georgia, Japan, Korea, Russia); NORTH AMERICA (Canada, Mexico, USA), CENTRAL AMERICA (Costa Rica); SOUTH AMERICA (Equador); AUSTRALIA and OCEANIA (Australia) (Pegler, 1983; Panus conchatus.., 2018).

Distribution in Russia: see Table 1.

Fig. 1. The most typical laterally attached morphotype of *Panus conchatus* (Kalinovskaya 4552M/12): *1* – an upperside view; *2* – a hymenophore. Scale bar – 1 cm.

Exsiccates examined. ***Panus torulosus***: “Sweden, Bohuslan, Uddevalla, Sarven Lake, on stump of *Betula* sp., X 1947. S. Woldmar LE 3722 (S. Lundell et J. A. Nannfeldt. Fungi exsiccati Suecici praesertim Upsalienses, N 1771)”. – “Sweden, Västergötland, Göteborg, Naturparken, on stump of Betula sp., 20 IX 1960. F. Karlvall LE 3723 (S. Lundell et J. A. Nannfeldt. Fungi exsiccati Suecici praesertim Upsalienses, N 2865)”. – “Sweden, Småland, Femsjö parish, on stump of *Betula* sp., 28 IX 1959. F. Karlvall LE 3721 (S. Lundell et J. A. Nannfeldt. Fungi exsiccati Suecici praesertim Upsalienses, N 2866)”. – “Russia, Khabarovsk Region, Ragozhino vicinities, on *Quercus* sp., 03 VI 1910. M. Korotkiy (M. Korotkiy. Museum Botanicum Academiae Scientiarum Petropolitanae, N 73)”. – “England, 15 III 1989. F. B. Delange LE 24071, LE 24074 (R. B. G. K. Richmond. Herbarium path/mixed debris England, N 73). – “USSR, Bashkortostan Republic, Bashkirsky Reserve, Drozdov Log vicinities, on stump of *Pinus sylvestris*, VIII 1948. E. A. Selivanova-Gorodkova LE 3703 (E. A. Selivanova-Gorodkova. Plantae australiuralenses, N 459)”.

Association with *Trametes multicolor*. According to our observations made on the Karelian Isthmus clear cuttings, *Panus conchatus* often settles on stumps, primarily colonized by *Trametes multicolor* (Schaeff.) Jülich (Fig. 2). Within ten records made for *Betula* stumps on the Karelian Isthmus clear cuttings, seven ones have contained an indication of the joint presence of *Panus conchatus* and *Trametes multicolor*. The latter species is an active producer of laccase and is characterized by high growth rate (Zmitrovich et al., 2017). Apparently, their primary delignification and moistening of wood by *T. multicolor* creates a niche for *Panus conchatus*, carrying out a deeper substrate delignification. The pair in question certainly echoes with another pair, *Antrodiella pallescens*/*Fomes*

Fig. 2. Association of *Panus conchatus* with *Trametes multicolor*-coll. (Zmitrovich 2014-12).

fomentarius, described for dead wood in boreal forests (Spirin, 2002).

Nomenclature. Two names sanctioned by Fries (1821) were considered in the literature as a fit basionyms of this species, *Agaricus conchatus* (Bulliard, 1787) and *A*. *torulosus* (Persoon, 1801). Since both names are sanctioned by Fries and there is no any doubt in their synonymy, the combination based on *A*. *conchatus* name, i. e. *Panus conchatus* (Fries, 1838), has a priority.

Intraspecific variability. As a neutral type of this species (***P*. *conchatus* var. *conchatus***) the more or less lateral ecotype with conchiform pileus and rather dark wine-red to lilac-brown surface is considered by default. Two main deviations from such neutral type were described: 1) the chromatic one, characterized by light-colored (red or clay-yellow), usually conchiform pilei (*P*. *conchatus* var. *inconstans*) and 2) the growth one, characterized by entral (often bulbous) stipe, funnel-shaped cap and strongly inrolled margin (*P*. *conchatus* var. *torulosus*).

Panus conchatus var. ***inconstans*** (Pers.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko, **comb. nov.** (MB 824338). – Basionym: *Agaricus inconstans* Pers., 1800, Comm. Schaeff. Icon. Pict.: 17.

= *A*. *conchatus* var. *carneotomentosus* Fr., 1832, Syst. Mycol. (Index): 11.

Persoon (1800) has characterized this taxon as follows: «*Subcespitosus*, *pileo carnoso tenaci depresso integro*, *aut dimidiato lobato flexuoso*, *ex alutaceo subrufescente*, *lamellis subramosis basi crispis albis subrutilesque*, *stipite brevi sublaterali*».

Icon.: Malkovský (1932: fig. 5, ut *Panus flabelliformis*).

From type variety differs by clay-buff, carneous of rufescent color of the upperside. Basidiocarps of conchoid appearance, the stipe often reduced and then the hymenophore is subporoid at the base. The microstructures vary as in a neutral type.

Panus conchatus var. ***torulosus*** (Pers.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko, **comb. nov.** (MB 824339). – Basionym: *Agaricus torulosus* Pers., 1801, Syn. meth. fung. 2: 475.

Icon.: Malkovský (1932: fig. 2, 3, 6 ut *Panus flabelliformis*).

From type variety differs by funnel-shaped basidiocarps on a central stipe, often with bulbous base, and inrolled undulating margin. The microstructures vary as in a neutral type (Fig. 3).

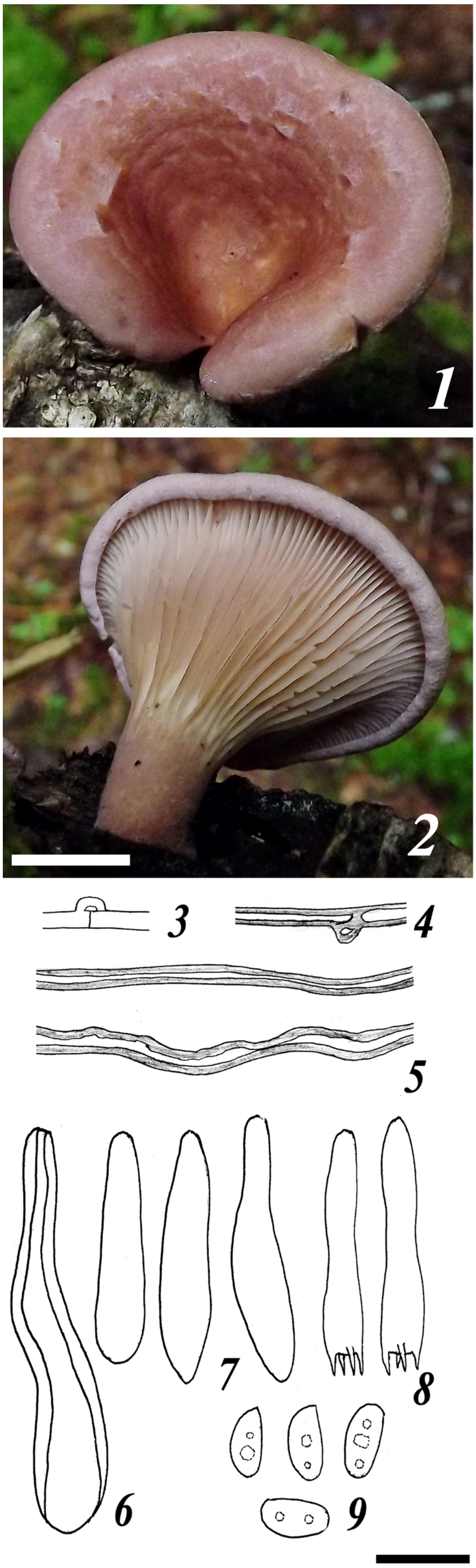

Fig. 3. *Panus conchatus* var. *torulosus* (Kalinovskaya 3850M/15): *1* – an upperside view; *2* – a hymenophore; *3* – generative hypha; *4* – pseudoskeletal hypha; *5* – fibrohyphae; *6* – pseudocystidium; *7* – cheilocystidia; *8* – basidia; *9* – basidiospores. Scale bars: *1*, *2* – 1 cm, *3*–*9* – 10 µm.

2. ***Panus lecomtei*** (Fr.) Corner, 1981, Beih. Nova Hedwigia 69: 90.

≡ *Lentinus lecomtei* Fr., 1825, Syst. Orb. Veg. 1: 77.

= *Agaricus strigopus* Pers. in Gaudichaud-Beaupré in Freycinet, 1827, Voy. Uranie., Bot.: 167.

= *A. hirtus* Secr., 1833, Mycogr. Suisse 2: 452.

= *A. macrosporus* Mont., 1837, Annls Sci. Nat., Bot., sér. 2 8: 370.

= *Panus rudis* Fr., 1838, Epicr. Syst. Mycol.: 398.

= *Lentinus capronatus* Fr., 1838, Epicr. Syst. Mycol.: 389.

= *A. sainsonii* Lév. in Demidov, 1842, Voyage dans la Russie Meridionale et la Crimeé, par la Hongrie, la Valachie et la Moldavie 2: 85.

= *Lentinus chaetophorus* Lév., 1844, Annls Sci. Nat. Bot. 2: 177.

= *L. melanophyllus* Lév., 1844, Annls Sci. Nat. Bot. 2: 175.

= *Panus lamyanus* Mont., 1856, Syll. gen. sp. crypt.: 147.

= *P. hoffmannii* Fr. in Hoffmann, 1867, Icon. Anal. Fung., Abbild. Beschr. Pilz. 1(4): 94.

= *Lentinus sparsibarbis* Berk. et M. A. Curtis, 1869, J. Linn. Soc., Bot. 10(no. 45): 301.

= *L. substrigosus* Henn. et Shirai in Hennings, 1900, Bot. Jb. 28(3): 270.

= *Panus semirudis* Singer, 1936, Beih. Botan. Centralbl. B 56: 142.

= *P. fragilis* O. K. Mill., 1965, Mycologia 57(6): 943.

= *P. neostrigosus* Drechsler-Santos et Wartchow, 2012, J. Torrey bot. Soc. 139(4): 438.

Icon.: Malkovský (1932: fig. 10–12, ut *P. rudis*); Zerova (1974: tab. 90, 1 ut *P. rudis*); Pegler (1983: fig. 31, ut *Lentinus strigosus*); Zmitrovich et al. (2004: Tab. 4, *a*, *b* ut *Panus rudis*); Bulakh (2015: fig. 418).

Basidiocarp solitary or caespitose, medium-sized, originating from a woody substratum, of lentioid habitus. Pileus 1.5–12 cm diam., tough fleshy, then coriaceous, convex, then depressed to infundibuliform, or laterally attached and flabelliform to spathulate. Upperside ivory-white to stramineous with prominent lilac or vinaceous tints, fading pale-ochraceous or grayish-brown, at first tomentose, then strigose (hairs 1–2 mm long), without a clear zonation. Margin thin, inrolling, slightly undulate or lobed, strongly strigose. Stipe eccentric to lateral, 0.5–3.8 × 0.3–1.5 cm, cylindric to bulbous, solid, sometimes reduced; surface concolorous with the pileus, tomentose-strigose. Context tough fleshy, then coriaceous, 1–7 mm thick at the disk, ivory-white. Hymenophore lamellate. Gills deeply decurrent, ivory-white to ochraceous-buff, sometimes with violaceous tints; initially very narrow but eventually becoming broader, 1–2 mm wide, very crowded, with lamellulae of four lengths; edge entire (Fig. 4).

Hyphal system dimitic with expressed pseudodimitic stage. Generative hyphae 2–4 μm diam., non-inflating, hyaline, thin-walled, branched, with large clamp connections. Skeletal hyphae 2–7.5 μm diam., unbranched, sinuose, hyaline, thick-walled to subsolid, the pseudoskeletal hyphae of the same diameter, bearing clamp connections and refractive contents, are abundant in young basidiocarps. Pileipellis a trichodermal epicutis, 25–45 μm thick, of repent, radially parallel generative hyphae 3–7.5 μm diam. with a golden-brown wall. Hymenophoral trama irregular, hyaline, of radiate construction, similar in structure to the context.

Fig. 4. The most typical laterally attached morphotype of *Panus lecomtei* (Myasnikov 4472A/15): *1* – an upperside view; *2* – a hymenophore. Scale bar – 1 cm.

Gills-edge sterile, with conspicuous, crowded, clavate to sublageniform cheilocystidia 18–35 × 4–6 µm, hyaline, thin- to thick-walled. Pleurocystidia (pseudocystidia) abundant, 25–55 × 9–13 µm, narrowly clavate, often sinuous and constricted, thick-walled, originating deep in the subhymenial layer and projecting up to 40 µm above the basidia. Basidia 15–20 × 3.5–5 µm, clavate-cylindrical, 4-spored, with a basal clamp. Basidiospores 4.5–6 × 2.5–3.7 µm, ovoid to ellipsoid-cylindrical, hyaline with few contents, thin-walled.

On dying trees, fallen logs and stumps, causing a white rot.

Substrata: On many hardwoods, especially *Carpinus betulus*, *Betula* spp., *Fagus sylvatica*, *Quercus* spp., rarely on conifers (*Larix* spp.).

Cultural characteristics: Hibbett et al. (1993); Grand (2004); Vargas-Isla, Ishikawa (2008); Petre, Tănase (2013).

General distribution: EUROPE (Bulgaria, Estonia, France, Germany, Hungary, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Ukraine); AFRICA (Madagascar, Mayotte, Uganda, Zaire); ASIA [India, Iran, Japan, Malaysia, Myanmar (Burma), Nepal, Pakistan, Philippines, Russia, Sri Lanka, Taiwan, Thailand, Turkey]; NORTH AMERICA (Canada, Mexico, USA), CENTRAL AMERICA (Costa Rica, Cuba, Guatemala, Honduras, Nicaragua, Panama, Puerto Rico); SOUTH AMERICA (Argentina, Brazil, Colombia, Guiana, Paraguay, Peru, Venezuela); AUSTRALIA and OCEANIA (Galapagos, Norfolk Island, Papua New Guinea, Australia) (Pegler, 1983; Panus neostrigosus .., 2018).

Distribution in Russia: see Table 2.

Exsiccates examined. ***Agaricus sainsonii***: "Russia, 1842. A. Demidoff LE 5848 (J. Leveillé. Voyage dans la Russie Meridionale et la Crimeé, N 85)". – ***Lentinus lecomtei***: "USA, Ohio, VII 1883. W. A. Kellermann LE 5849 (Rabenhorst–Winter. Fungi Europaei, N 2940)". – ***Panus rudis***: "Austria, trunk of *Fagus sylvaticus*. P. P. Strasser LE 5854 (P. P. Strasser. Kryptogamae exsiccatae, N 1422)". – "Georgia, Tiflis Hortus Botanicus, 12 X 1923. G. Woronow LE 208198 (G. Woronow. Fungi Caucasici, N 2127)". – "Russia, Tomsk Region, on stump of *Betula* sp., 3 III 1926. Lavrov LE 5803 (A. A. Jaczewski. Ex Herbario Instituti Mycologici et Phytopathologici, N 81)". – "Austria, Salzburg, on fallen trunk of *Fagus sylvatica*, 1914 C. Keissler LE 5851 (C. Keissler. Kryptogamae exsiccatae, N 1422)". – "Baton Range, 23 II 1960. B. Lowy LE 5845 (B. Lowy. Ex Mycological Herbarium of Louisiana State University)". – "Russia, Bashkortostan Republic, Bashkirsky reserve, Drozdov Log vicinities, on stump of *Betula* sp., 8 IX 1946 E. A. Selivanova-Gorodkova LE 5838 (E. A. Selivanova-Gorodkova. Plantae australiuralenses, N 2427)." – "Russia, Bashkortostan Republic, Bashkirsky reserve, Drozdov Log vicinities, on stump of *Betula* sp., 8 IX 1946 E. A. Selivanova-Gorodkova LE 5834 (E. A. Selivanova-Gorodkova. Plantae australiuralenses, N 2429). – ***Panus sainsonii***: "Austria, Salzburg, IX 1868 Dr. Sauter LE 5855 (Rabenhorst–Winter. Fungi Europaei, N 1207)". – "Austria, Salzburg, on fallen trunk of *Fagus*. Dr. Sauter LE 5850 (F. Thümen. Fungi austriaci, N 212)".

Nomenclature. Two names in application to this peculiar species persisted in the literature for a long time, *Lentinus strigosus* and *Panus rudis*. Since, as it was shown, this species does not belong to the *Lentinus* s. str. (Zmitrovich, Malysheva, 2013; Zmitrovich, Kovalenko, 2016), it became necessary a nomenclatural adaptation of species name within the *Panus*. Because of the name *P. strigosus* Berk. et M. A. Curtis was preoccupied by Berkeley and Curtis (1859) in application to another species, the name *P. rudis* (Fries, 1838) continued to be persisting. Drechsler-Santos et al. (2012) proposed new name *P. neostrigosus* without any nomenclature analysis, and this name was taken as a basis for GBIF (Panus neostrigosus .., 2018). At the same time, Corner (1981) already made a combination *P. lecomtei*, basing on the description by Fries *Lentinus lecomtei* in his earlier work (Fries, 1825).

Intraspecific variability. As a neutral type of *Panus lecomtei* (*P. lecomtei* var. *lecomtei*), the ecotype having small eccentric to lateral minute and often spalled stipe is considered by default. However, the stipe shape and size are variable. The stipe can be either central – minute, with a bulbous base (*P. lecomtei* var. *semirudis*), or strongly elongated (*P. lecomtei* var. *stipitata*).

Panus lecomtei var. ***semirudis*** (Singer) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko, **comb. nov.** (MB 824340). – Basionym: *Panus semirudis* Singer, 1936, Beih. Botan. Centralbl., Abt. B 56: 142.

From type variety is distinguished by short, but strong and often bulbous stipe of central or subcentral position. Upperside is moderately strigose to glabrous at the center, color usually fading to ochraceous-brown. The microstructures vary as in a neutral type (Fig. 5).

Panus lecomtei var. ***stipitatus*** (Malk.) Zmitr., Bondartseva, Perevedentseva, Myasnikov et Kovalenko, **comb. nov.** (MB 824341). – Basionym: *Panus rudis* f. *stipitata* Malk., 1932, Annls mycol. 30(1/2): 40.

Icon.: Malkovský (1932: fig. 12, ut *Panus rudis* f. *stipitata*).

From type variety is distinguished by long lateral or eccentric stipe and spathulate pilei. Upperside is strongly strigose, color usually fading to cinnamon. The microstructures vary as in a neutral type (Fig. 6).

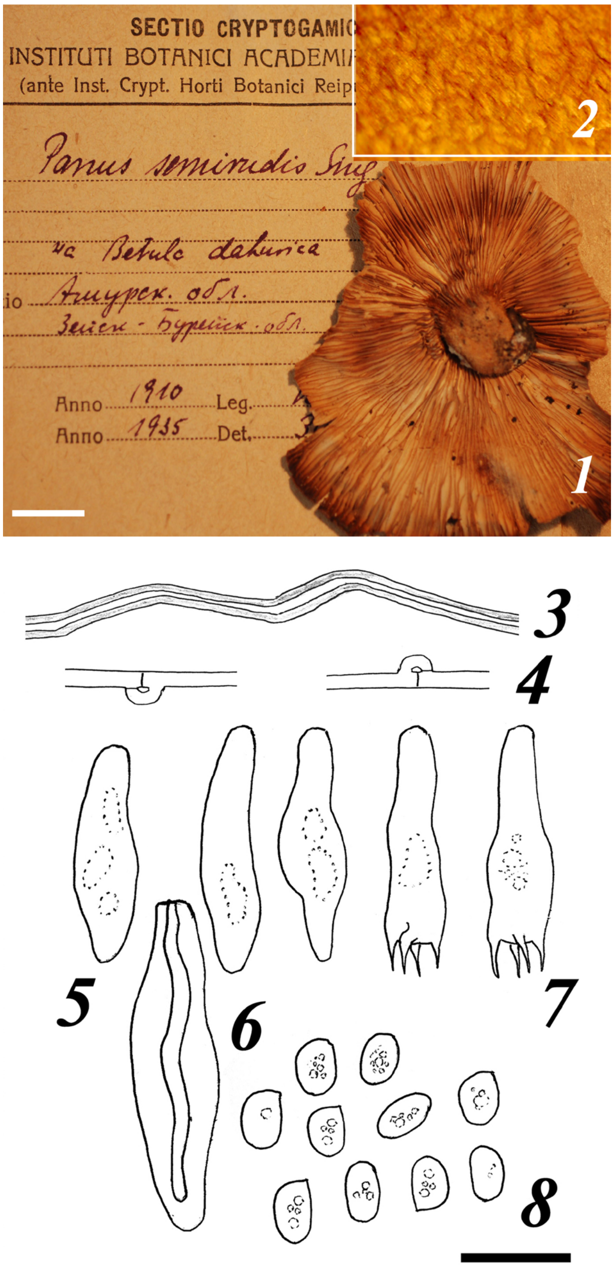

Fig. 5. *Panus lecomtei* var. *semirudis* (LE 3660): *1* – hymenophore; *2* – upperside view; *3* – fibrohypha; *4* – generative hyphae; *5* – cheilocystidia; *6* – pseudocystidium; *7* – basidia; *8* – basidiospores. Scale bars: *1*, *2* – 1 cm, *3*–*8* – 10 µm.

The problem of *Lentinus martianoffianus*. This problematic species was described by Thümen (1877) with reference to Kalchbrenner, and its authentic material kept in Kew Herbarium (K). There is a single specimen, collected on *Populus balsamifera* by Martianoff near Minussinsk in 1880 and distributed within exsiccate series by Thümen (Fung. Exot. Dec. 21).

The Kew material was studied by Pegler (1983) and described as follows: "Imbricate. Pileus laterally attached, 3–5 cm diam., thin, coriaceous, irregularly flabelliform, depressed; surface pale yellowish rufous, uniformly velutinate-strigose becoming hispid towards the margin; margin irregular, deeply lobed, faintly sulcate, densely ciliate with hair-like squamules, 1–2 mm long. Lamellae decurrent, pallid, narrow, about 1 mm wide, very crowded, with lamellulae of three lengths; edge entire. Stipe lateral, 1–1.5 cm × 8–12 mm, short, cylindric or compressed, solid; surface concolorous with the pileus, densely strigose, glabrescent. Context up to 2 cm

Fig. 6. *Panus lecomtei* var. *stipitatus* (Myasnikov 4350A/16): *1* – upperside view; *2* – hymenophore. Scale bar – 1 cm.

thick at the base, very thin over the hymenophore, white, consisting of a dimitic hyphal system with skeletal hyphae. Generative hyphae 2–5 µm diam., not inflating, hyaline, branched, thin-walled or occasionally with a slightly thickened wall, and clamp-connexions. Skeletal hyphae 2–6 µm diam., unbranched, hyaline, with a thickened wall (up to 2 µm) and a narrow lumen, intercalary and terminal in origin, finally tapering to an obtusely rounded apex. Spores 4.7–6.2 × 1.7–2.5 µm, Q = 2.37, narrowly cylindric, at times arcuate, hyaline, thin-walled, with few contents. Basidia 16–22 × 4.5–5.5 µm, clavate, bearing four sterigmata. Lamella-edge sterile, forming a narrow zone of small, inconspicuous cheilocystidia, together with scattered metuloids. Cheilocystidia 16–24 × 3.5×5 µm, basidioid, sinuous fusoid, often constricted, with a rounded apex, hyaline, thin-walled. Metuloids scattered to numerous, on both sides and edge of lamellae, 26–45 × 7–12 µm, inflated clavate to fusoid-submucronate, usually with a thickened wall (1–2.5 µm) and resinous, yellowish brown contents, projecting to 25 µm beyond the basidia, sometimes surrounded by a sheath of thin-walled, generative hyphae, 2–5 µm diam. Hymenophoral trama irregular, hyaline, of radiate construction, comprising mostly of generative hyphae. Subhymenial layer well developed, 14–20 µm wide, tightly interwoven. Pileipellis a disrupted and irregular trichodermial palisade, forming fascicles of unbranched, sclerified generative hyphae, 4–6 µm diam., with an obtusely rounded apex" (Pegler, 1983).

Since the molecular testing of any Kew material is prohibited, only the morphological description may be considered on, which unambiguously indicates the close relationships of this taxon with *Panus lecomtei*-coll. Only basidiospores are something diverse, since are not ovoid, but rather ellipsoidal-cylindrical. Malkovský (1932) has considered *Lentinus martianoffianus* as a synonym of *Panus rudis*, whereas Pegler (1983) has abstained from synonymization procedure. In any case, this taxon belongs to the genus *Panus*, although there have been attempted to associate this name with the *Lentinus*

Table 1
Herbarium data on distribution of Panus conchatus over Russian territory and its substrate preferences

Region	Substrata	Date of collection	Collector	Herbarium numbers
European part				
Karelia Republic	*Betula pubescens*	08 X 1950	A. S. Bondartsev	LE 3704
Leningrad Region	unidentified substrate	19 VIII 1960	M. A. Bondartseva	LE 3702
Leningrad Region	*Betula pubescens*	20 VII 2014	I. V. Zmitrovich	LE 287527
Leningrad Region	*Populus tremula*	05 VIII 2001	I. V. Zmitrovich	LE 212955
Leningrad Region	*Betula* sp.	23 VI 1997	O. V. Morozova	LE 215053
Leningrad Region	unidentified substrate	07 X 2007	N. V. Psurtseva	LE 265028
Leningrad Region	unidentified substrate	VIII 1918	V. P. Savich	LE 3716
Mari El Republic	*Betula* sp.	14 VI 1938	B. P. Vasilkov	LE 3708
Mari El Republic	*Populus* sp.	03 VII 1935	B. P. Vasilkov	LE 3713
Moscow Region	*Betula* sp.	19 VIII 1925	L. A. Lebedeva	LE 3715
Moscow Region	unidentified substrate	17 VI 2016	O. V. Anisimova	LE 315401
Orel Region	*Betula* sp.	06 VIII 1912	A. S. Bondartsev	LE 3718
Pskov Region	unidentified substrate	23 VII 2002	O. V. Morozova	LE 217599
Saint Petersburg	unidentified substrate	27 IX 1994	O. V. Morozova	LE 227995
Stavropol Territory	unidentified substrate	15 VIII 1925	A. I. Lobik	LE 3711
Tver Region	unidentified substrate	VII 1924	L. A. Lebedeva	LE 3712
Vologda Region	*Betula* sp.	25 VIII 2002	E. S. Popov	LE 246368
Urals				
Perm Territory	*Populus tremula*	15 VIII 1994	L. G. Perevedentseva	PERM 118-3
Siberia				
Irkutsk Region	*Populus tremula*	15 VIII 1983	A. E. Kovalenko	LE 18116
Irkutsk Region	*Betula* sp.	20 VIII 1947	B. P. Vasilkov	LE 3710
Irkutsk Region	*Betula* sp.	26 VIII 1947	B. P. Vasilkov	LE 3714
Irkutsk Region	*Betula* sp.	27 VIII 1947	B. P. Vasilkov	LE 3707
Krasnoyarsk Territory	*Betula* sp.	11 IX 1965	A. L. Yavorskiy	LE 3705

piloso-squamulosus Lj. Vassilieva (current name is *Lignomyces vetlinianus*) (Bulakh, 2015).

Conclusion

The *Panus* represents rather well-delimited genus belonging to merulioid phylogenetic radiation, whose morphotype on essential features of its organization is trametoid, but superficial habitual features make it closer to the lentinoid one. One of its essential features is the abundance of fibrohyphae which forms a *textura intricata*, slowly growing basidiocarps and strictly lamellate hymenophore. Apparently, such an adaptive structure was generated under the influence of arid and warm climate conditions at the different regions of the planet, and only 2 species, *Panus conchatus*, and *P. lecomtei*, have been irradiated into temperate latitudes, including Russian territory. The substrate spectrum of these fungi is determined by their insensitivity to the substrate moistening and best ability to colonize

Table 2

Herbarium data on distribution of Panus lecomtei over Russian territory and its substrate preferences

Region	Substrata	Date of collection	Collector	Herbarium numbers
European part				
Adygeya Republic	*Fagus sylvatica*	V 1910	N. Shestunov	LE 5815, LE 5817, LE 5827
Adygeya Republic	*Fagus sylvatica*	18 IX 2003	N. V. Psurtseva	LE 241942
Kirov Region	unidentified substrate	23 VII 1921	M. K. Khokhryakov	LE 5799
Krasnodar Territory	unidentified substrate	13 VIII 2003	N. V. Psurtseva	LE 227998
Krasnodar Territory	unidentified substrate	31 VII 1979	A. E. Kovalenko	LE 5837
Krasnodar Territory	unidentified substrate	17 VII 1976	A. E. Kovalenko	LE 5829
Leningrad Region	*Betula pubescens*	06 VII 1998	I. V. Zmitrovich	LE 214737
Mari El Republic	unidentified substrate	10 VI 1932	B. P. Vasilkov	LE 5832
North Ossetia–Alainia Republic	*Carpinus betulus*	15 V 1925	Z. Chernetskaya	LE 5813
Penza Region	*Betula* sp.	27 VII 1921	Shtukenberg	LE 5841
Ryazan Region	unidentified substrate	IX 1960	G. K. Milberg	LE 5828
Stavropol Territory	unidentified substrate	24 VIII 1915	A. I. Lobik	LE 5836
Voronezh Region	unidentified substrate	1946	V. Ya. Chastukhin	LE 5833
Urals				
Perm Territory	*Betula pendula*	25 VIII 1980	L. G. Perevedentseva	PERM 118-1
Perm Territory	*Betula pendula*	30 VIII 1985	L. G. Perevedentseva	PERM 118-2
Perm Territory	*Betula pendula*	22 VIII 1999	L. G. Perevedentseva	PERM 118-4
Perm Territory	*Betula pendula*	04 VIII 2004	L. G. Perevedentseva	PERM 118-5
Siberia				
Altai Republic	*Betula* sp.	17 VIII 2008	N. V. Psurtseva	LE 254518
Altai Republic	*Betula* sp.	18 VIII 2008	N. V. Psurtseva	LE 254519
Altai Republic	*Populus* sp.	VIII 1937	R. Singer	LE 5842
Chita Region	unidentified substrate	V 08.1910	no data	LE 5812
Irkutsk Region	*Betula* sp.	20 VIII 1921	T. Smirnov	LE 5804
Irkutsk Region	*Betula* sp.	04 IX 1947	B. P. Vasilkov	LE 5805
Tumen Region	unidentified substrate	20 VI 1914	Varentsov	LE 5831
Yakutia Republic	*Larix* sp.	10VIII1908	N. A. Palchevskiy	LE 5844
Far East				
Amur Region	*Quercus* sp.	17VII1959	B. A. Tomilin	LE 5791
Amur Region	unidentified substrate	13VI1910	M. Korotkiy	LE 3663
Primorye Region	unidentified substrate	1913	V. L. Komarov	LE 3664
Primorye Region	unidentified substrate	29VI1913	V. L. Komarov	LE 5840
Primorye Region	*Betula dahurica*	19VII1934	B. Kolesnikov	LE 5797
Primorye Region	*Quercus* sp.	15 VII 1952	E. V. Volkova	LE 5808
Sakhalin Region	*Larix decidua*	1960	B. P. Vasilkov	LE 5839
Sakhalin Region	*Sorbus aucuparia*	29 VIII 1954	M. G. Tarabaev	LE 5820

hardwood, so the greatest number of their finds can be made on stumps and large remnants of standformers of corresponding forest areas. In Russia, a reliable association of *Panus* species to *Betula* spp. and *Populus* spp. was revealed. An ecotypic differentiation of the genus *Panus* is related to the quality of substrate colonized. The basidiocarps, growing over top cuts of the stumps, are characterized by strong central stipe (*P. conchatus* var. *torulosus*, *P. lecomtei* var. *semirudis*), whereas basidiocarps with sublateral attachment are common on fallen logs. Certain chromatic aberrations (*P. conchatus* var. *inconstans*) are associated with an insolation regime of the habitat. During last years, the *Panus* representatives have attracted an interest in biomedical research development. Their resource potential estimation should proceed from the fact that within Russian territory, such areas as Middle Belt of European Russia, North Caucasus, Altai and other regions of Southern Siberia are promising for replenishing the strains of *P. conchatus* and *P. lecomtei*.

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