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# AGARICOID FUNGI NEW TO NOVGOROD REGION, RUSSIA

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**Abstract**

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Brief research history and new records of agaricoid basidiomycetes from Novgorod Region are provided. Twenty-three species of agaricoid fungi are reported for the first time from Novgorod Region, five species (*Gamundia striatula*, *Mycena erubescens*, *Mycetinis querceus*, *Pholiotina brunnea*, *Sagaranella tylicolor*) are new to the North West of European Russia, three species (*Baeospora myriadophylla*, *Entoloma strigosissimum*, *Mycena renati*) are threatened.

**Keywords**: agaricoid fungi, biodiversity, distribution, mycobiota, Novgorod Region, threatened species.

## INTRODUCTION

Novgorod Region lies within the North West of European Russia and borders Leningrad, Pskov, Tver' and Vologda Regions. It occupies the territory between 59°20' N–56°55' N (250 km from north to south) and 29°40' E–36°10' E (385 km from west to east). Approximate area of the region is 54 500 km$^2$ (Serova et al., 1970).

The region is located on the northwest of East European Platform within the Priilmenskaya Lowland and the Valdaiskaia Upland that were formed before Valdai glaciation. The territory of the region is characterized by the undulating to hilly recessional moraine with almost plain plots on the Priilmenskaya Lowland with Lake Ilmen' in the centre. Climate is temperate-continental with warm short humid summers and mild winters. The northern part of the region lies within the southern taiga and the southern part within coniferous-broadleaved forests (Alexandrova & Yurkovskaya, 1989).

First scattered data on agaricoid fungi can be found in a few papers (Rusakov, 1968; Kovalenko & Morozova, 1999). Systematic investigation on diversity of agaricoid basidiomycetes has begun since early 2000s. Conjoint team of researchers from Russia (O.V. Morozova, A.E. Kovalenko and others) and the USA (R.H. Petersen and R. Halling) performed inventory studies of Valdaisky National Park and its vicinities (Valdaisky, Okulovsky and Demyansky districts) in 2001–2003. The results were published in 2005 (Kovalenko et al., 2005) and, actually, the paper is the first significant contribution to the knowledge about agaricoid basidiomycetes diversity in the region as it contains the annotated list of 256 species. In the same year, E.F. Malysheva with colleagues performed the research in three regional protected areas (Savinskie Dubravy, the Vostochno-Ilmensky State Reserve, and Ilmensky Glint) and adjacent territories located in Novgorodsky and Krestetsky districts. The results have been summarized in two papers (Malysheva et al., 2006, 2007). The first one provides comprehensive information on six rare species; the second includes an annotated list of 76 species of agaricoid basidiomycetes as well as aphyllophoroid and heterobasidiod fungi. Since 2008, S.N. Arslanov has been investigating Malovishersky district, and up to date the results have been published in three papers, which contain the

annotated list with 22, 13 and 23 species, respectively (Arslanov, 2012, 2014; Svetasheva et al., 2017). In 2012, O.V. Morozova with colleagues visited perspective protected area, the Luga River near Novoe Ovsino village in the valley of the Luga River, located in Batetsky district, and recorded 22 species there (Morozova et al., 2014). In 2014, A.D. Baklan studied the diversity of basidiomycetes in Pestovsky district, and listed 25 species of agaricoid fungi (Baklan, 2015) as well as aphyllophoroid ones.

Since 2007, the collections from Novgorod Region have been treated in a list of taxonomical works or those on rare or new species (Hughes et al., 2007; Adamčík & Ripková, 2008; Malysheva & Morozova, 2009; Malysheva et al., 2009; Malysheva & Kiyashko, 2011; Kovalenko et al., 2012; Morozova & Popov, 2013; Justo et al., 2014; Morozova et al., 2014; Petersen et al., 2015; Malysheva, 2018; Morozova et al., 2018).

Monograph "Mycobiota of Belorussko-Valdayskoe Poozerje" (Popov et al., 2013) should be mentioned as it summarizes the data from Valdaisky and adjacent districts in the annotated list, including records of 315 species of agaricoid basidiomycetes among other fungi in the broad sense. The territory of these administrative districts lies within landscape area Belorussko-Valdaiskoe Poozerje, chosen by authors as the investigation area.

Since 1968, 452 species have been registered new to Novgorod Region (Fig. 1). Valdaisky, Okulovsky and Malovishersky districts are investigated more than others (Fig. 2). The present paper contributes to the knowledge about agaricoid fungi diversity and slightly widens the researched area by the records from the previously non-investigated Chudovsky district.

## MATERIALS AND METHODS

### Study area

The studies were performed in three localities situated in the Priilmenskaya Lowland (Fig. 2). The first protected area "Volynskie Dubravy" (Novgorodsky district) is situated near Volyn' village between the Rivers Vishera and Sosnitsa. Apart from mixed stands (*Picea*, *Populus*, *Betula*), oak forests with *Pinus*, *Betula*, *Alnus* are found in the area. The second protected area "Savinskie Dubravy" (Novgorodsky district) is located near Savino village in the basin of the River Bolshaya Vishera. Forests dominated by *Quercus robur* with the admixture of *Populus tremula*, *Betula*, *Picea* and undergrowth of *Padus*, *Frangula*, *Sorbus* cover the territory. The third one, vicinities of Krasnofarforny settlement (Chudovsky district), is located between Sominskoe Lake and the River Volkhov in the floodplain of the latter. Willow scrubs and sticky alder forests cover the lowlands. Oak forests with *Ulmus*, *Tilia*, *Alnus*, *Populus tremula*, *Corylus avellana* and undergrowth of *Padus*, *Salix*, *Rosa* lies on the dominant ridges.

### Data sampling

The author collected specimens in 2017–2018 in the above-mentioned localities. Fresh material was studied according to standard methods used in fungi

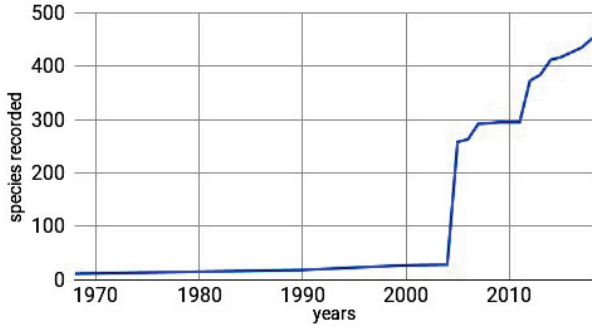


Fig. 1. Cumulative curve of increase of numbers of agaricoid species from Novgorod Region since 1968 to nowadays

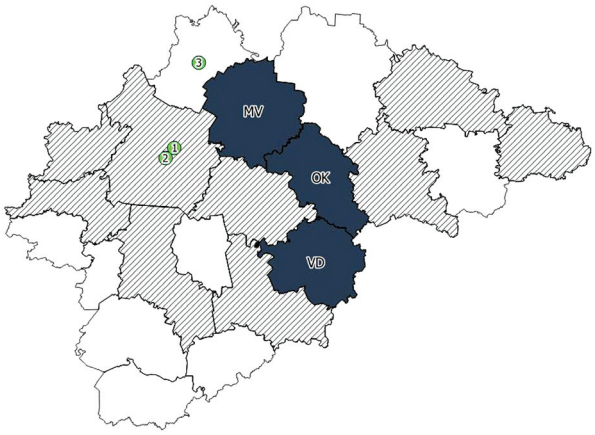


Fig. 2. Localities of collections: 1 – Novgorodsky district, protected area "Volynskie Dubravy"; 2 – Novgorodsky district, protected area "Savinskie Dubravy"; 3 – Chudovsky district, vicinities of Krasnofarforny settlement. District study coverage is designated as follows: white – no species registered; hatching – species number from 1 to 50; grey – more than 50 species recorded (MV – Malovishersky, OK – Okulovsky, VD – Valdaisky)


Fig. 3. Basidiomata (a, c, d, e) and basidiospores (b, f) of: a, b – *Gamundia striatula,* LE 321767; c – *Pholiotina brunnea,* LE 321780; d – *Sagaranella tylicolor,* LE 321771; e, f – *Xerocomellus riparielus,* LE 321782

taxonomy (Ivoilov et al., 2017). Macroscopic descriptions are based on the observations made in the field or shortly after collecting the fresh material. Microscopic structures were observed in squash preparations of small parts of dried basidiomata mounted in 5% KOH or 1% Congo Red in 10% $NH_4OH$ and Melzer's reagent using Axio Imager A1 microscope. For dimensions of basidiospores, basidia and cystidia, at least 10 measurements were taken. The basidia were measured without sterigmata and the spores without hilum. All specimens are deposited at the Mycological Herbarium of the Komarov Botanical Institute RAS (LE).

## RESULTS AND DISCUSSION

### Species list

The list of species new to Novgorod Region is provided. The nomenclature of taxa follows the Index Fungorum (2019).

An annotated record includes information on locality, date of collection, herbarium number. The species new to the North West of European Russia are marked with *, and provided with the description of the studied specimens. Threatened species are commented.

***Baeospora myriadophylla*** (Peck) Singer – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’09” N, 31°48’55” E, floodplain oak forest, on moss-covered trunk, 27 June 2017, LE 321759.

Threatened species (Vasin & Vasina, 2013; Hyvärinen et al., 2019).

***Coprinopsis urticicola*** (Berk. & Broome) Redhead, Vilgalys & Moncalvo – Novgorodsky district, 58°36’07” N, 31°31’57” E, protected area “Volynskie Dubravy”, in grass on the roadside, on plant remnants, 6 July 2018, LE 321760.

***Cortinarius bibulus*** Quél. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’24” N, 31°48’47” E, floodplain oak forest, on moss-covered trunk, 22 July 2017, LE 321761.

***Crepidotus applanatus*** (Pers.) P. Kumm. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°08’28” N, 31°47’44” E, floodplain oak forest, on trunk, 14 July 2018, LE 321762.

***Crepidotus crocophyllus*** (Berk.) Sacc. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’07” N, 31°50’11” E, floodplain oak forest, on moss-covered hardwood trunk, 22 July 2017, LE 321763.

***Delicatula integrella*** (Pers.) Fayod – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’23” N, 31°48’47” E, floodplain oak forest, on moss-covered hardwood trunk, 22 July 2017, LE 321764.

***Entoloma strigosissimum*** (Rea) Noordel. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’15” N, 31°49’00” E, floodplain oak forest, on moss-covered hardwood trunk, 14 July 2018, LE 321765.

Threatened species (Geltman, 2018; Hyvärinen et al., 2019).

***Galerina jaapii*** A.H.Sm. & Singer – Chudovsky district, vicinities of Krasnofarforny settlement, 59°08’28” N, 31°47’44” E, floodplain oak forest, in moss, 14 July 2018, LE 321766.

****Gamundia striatula*** (Kühner) Raithelh. (Fig. 3a, b) – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’09” N, 31°48’55” E, floodplain oak forest, in moss on decayed hardwood trunk, 27 June 2017, LE 321767.

The specimen is represented by three basidiomata. Pileus 10–15 mm in diameter, pale beige with somewhat darker centre, distinctly striate, with central depression. Stipe 20–35 × 2–5 mm, cylindrical, almost concolour with pileus, slightly darker at the base. Lamellae white, moderately distant, broadly adnate to slightly decurrent. Odour indistinct, taste mild. Basidiospores 6.0–6.7 × 4.2–4.9 µm, ellipsoid to broadly ellipsoid, minutely echinulate, sometimes ornamentation is hardly visible even under the immersion. Basidia 25–30 × 8–10 µm, 4–spored, clavate. Cheilocystidia and pleurocystidia 45–80 × 10–18 µm, clavate to subcylindrical.

Typical features of the species are striate pileus with a central depression and minutely echinulate ellipsoid to broadly ellipsoid spores (Antonín & Noordeloos, 2004).

***Lacrymaria lacrymabunda*** (Bull.) Pat. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’18” N, 31°48’37” E, floodplain oak forest, on soil, 25 August 2018, LE 321768.

***Lentinus tigrinus*** (Bull.) Fr. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°08’28” N, 31°47’44” E, floodplain oak forest, on fallen trunk, 14 July 2018, LE 321769.

***Lepiota felina*** (Pers.) P. Karst. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’20” N, 31°50’13” E, floodplain oak forest, on soil, 20 September 2018, LE 321770.

***Marasmius cohaerens*** (Alb. & Schwein.) Cooke & Quél. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’17” N, 31°48’46” E, floodplain oak forest, on litter, 20 September 2018, LE 321772.

****Mycena erubescens*** Hohn. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07’15” N, 31°49’00” E, floodplain oak forest, on fallen moss-covered trunk, 25 August 2018, LE 321775; ibid., 59°07’14” N, 31°50’31” E, at the moss-covered base of *Quercus robur* L., 11 October 2018, LE 321783.

Specimens LE 321775 and LE 321783 are represented by seven and five basidiomata, accordingly. Pileus 6–9 mm in diameter, conical to broadly conical, greyish brown with bluish tinge. Stipe 30–50 × 0.5–1.0 mm, cylindrical, hollow, concolour to pi-

leus. Lamellae rather distant, ventricose, greyish, adnexed to emarginate. Odour indistinct or slightly farinaceous, taste very bitter. Basidiospores 8.0–11.0 × 7.0–9.0 µm, broadly pip-shaped, smooth. Basidia 25–30 × 8–10 µm, clavate, 2–spored. Cheilocystidia 30–60 × 10–15 µm, variable in form: from fusiform, sometimes with long neck to clavate with curved excrescences. Pleurocystidia 40–70 × 17–20 µm, fusiform, numerous.

Bitter taste, variable cheilocystidia, abundant fusiform pleurocystidia, and broadly pip-shaped spores are the main diagnostic features of the species (Aronsen & Læssøe, 2016).

***Mycena renati*** Quél. – Novgorodsky district, protected area "Savinskie Dubravy", floodplain oak forest, 58°32'25" N, 31°26'40" E, on fallen branches, 6 July 2018, LE 321776.

Threatened species (Geltman, 2018; Hyvärinen et al., 2019).

***Mycena tenerrima*** (Berk.) Quél. – Novgorodsky district, protected area "Savinskie Dubravy", 58°32'24" N, 31°26'49" E, floodplain oak forest, on acorn peduncules, 16 August 2018, LE 321774.

***Mycenella margaritispora*** (J.E. Lange) Singer – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07'15" N, 31°49'00" E, floodplain oak forest, on moss-covered hardwood trunk, 14 July 2017, LE 321777.

****Mycetinis querceus*** (Britzelm.) Antonín & Noordel. – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07'12" N, 31°50'31" E, floodplain oak forest, on fallen leaves of *Quercus robur*, 11 October 2018, LE 321778.

Specimen is represented by six basidiomata. Pileus 10–25 mm in diameter, almost applanate, hygrophanous, pale brown. Stipe 20–60 × 1.5–3 mm, cylindrical, brown, with whitish mycelium at the base. Lamellae are rather crowded, slightly ventricose, whitish. Odour and taste like garlic. Basidiospores 7.5–10.2 × 4.0–5.5 µm, ellipsoid, smooth, hyaline. Basidia 30–35 × 6.5–9.0 µm, clavate. Cheilocystidia and pleurocystidia absent.

Strong garlic smell, growth on *Quercus* leaves (never on wood), narrow spores and lack of cheilocystidia are the typical features of the species (Antonín & Noordeloos, 2010).

****Pholiotina brunnea*** Watling (Fig. 3c) – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07'17" N, 31°48'48" E, floodplain oak forest, on litter, 22 July 2017, LE 321780.

The specimen is represented by two basidiomata. Pileus 10–15 mm in diameter, convex, brownish with orange tinge, smooth, with triangle remnants of veil on margin. Stipe 20–40 × 1.2–2.5 mm. Lamellae pale ochre, moderately crowded, adnate, ventricose. Odour and taste not recorded. Basidiospores 7.5–8.5 × 4.5–5.5 µm, phaseoliform or narrow ellipsoid, with small pore, smooth. Basidia 20–30 × 7.0–9 µm, 4–spored, clavate. Cheilocystidia 20–35 × 10–15 µm, lecythiform. Pleurocystidia absent.

The species can be identified by pileus colour (with orange tinges), distinct triangle veil remnants on pileus margin, lecythiform cystidia, and peculiar proportions of phaseoliform spores (Malysheva, 2018).

***Pluteus hispidulus*** Schreurs – Chudovsky district, vicinities of Krasnofarforny settlement, 59°07'15" N, 31°49'00" E, floodplain oak forest, on moss-covered trunk, 11 October 2018, LE 321779.

***Pluteus inquilinus*** Romagn. – Novgorodsky district, protected area "Savinskie Dubravy", 58°32'24" N, 31°26'54" E, floodplain oak forest, on fallen trunk, 17 August 2018, LE 321781.

****Sagaranella tylicolor*** (Fr.) V. Hofst., Clémençon, Moncalvo & Redhead (Fig. 3d) – Novgorodsky district, protected area "Volynskie Dubravy", 58°36'07" N, 31°31'57" E, floodplain oak forest, near the roadside, on soil, 6 July 2018, LE 321771.

The specimen is represented by two basidiomata. Pileus 15–20 mm, broadly conical to plano–convex, greyish beige, with a darker centre and slightly striate margin. Stipe 40–60 × 3–5 mm, cylindrical, concolour with the pileus, covered with thin whitish fibrils. Lamellae moderately crowded, ventricose, pale beige, almost free. Odour indistinct, taste not recorded. Basidiospores 6.5–8.0 × 4.5–6.0 µm, broadly ellipsoid, echinulate. Basidia 25–30 × 6–8.5 µm. Cystidia absent.

Somewhat mycenoid habitus, white spore print, distinctly echinulate spores, and absence of cystidia are the main diagnostic character of the species (Knudsen & Vesterholt, 2012).

***Xerocomellus riparіellus*** (Redeuilh) Šutara (Fig. 3e, f) – Novgorodsky district, protected area "Savinskie Dubravy", 58°32'26" N, 31°26'50" E, floodplain oak forest, on soil, 16 August 2018, LE 321782.

## DISCUSSION

To date, 475 species of agaricoid basidiomycetes, including 23 new species presented in the paper, are known in the region. Five species were recorded from Novgorodsky district, and 17 species from Chudovsky district that had not been previously investigated. Five species (*Gamundia striatula*, *Mycena erubescens*, *Mycetinis querceus*, *Pholiotina brunnea*, *Sagaranella tylicolor*) were recorded for the first time in the North West of European Russia. *Gamundia striatula* is rather rare, but widely distributed (Antonín & Noordeloos, 2004). *Mycena erubescens* and *Mycetinis querceus* are considered as common species in nemoral area, typical of deciduous forests (Aronsen & Læssøe, 2016; Antonín & Noordeloos, 2010). *Pholiotina brunnea* is widely distributed (Malysheva, 2018), but the record from Novgorod Region is remarkable as it constitutes the northernmost finding of the species in Russia. *Sagaranella tylicolor* belongs to the peculiar group of ammonia-fungi and the species has been recorded from urea plots in various geographical areas, irrespective of vegetation (Suzuki, 2017).

Another noteworthy record is *Xerocomellus riparielllus*. The finding of *Xerocomellus riparielllus* is the second to the North West of European Russia and the third to the whole Russia. It is known from Udmurt Republic (Kapitonov, 2013) and Leningrad Region (Volobuev et al., in press). Probably, the species is more common and widespread, but it can be confused in the field with *Xerocomellus rubellus* (Krombh.) Šutara and similar red-coloured boletes.

Also, among species that have already been found in the North West of Eastern Russia, *Baeospora myriadophylla*, *Entoloma strigosissimum* and *Mycena renati* deserve attention as they are considered as threatened. *Baeospora myridophylla* is concerned to be associated with old-growth dark coniferous forests and coarse wood debris of *Abies sibirica* (Vasin & Vasina, 2013) and *Populus tremula* (Filippova, pers. comm.). The specimen from Novgorod Region was found in floodplain oak forest on a large moss-covered log of *Quercus*, same year finding from Leningrad Region (Kalinina, 2018) was made in oak forest with *Populus*, *Betula*, *Pinus* on rotten *Betula* stump. Probably the species prefers old-growth non-managed forests (not necessarily dark coniferous) as it develops on large logs and stumps irrelevant of tree species. It is considered as widely distributed, but rare species (Castellano et al., 2003), listed as endangered in Finland (Hyvärinen et al., 2019), and included into the Red Data Book of Yugra (Vasin & Vasina, 2013). *Entoloma strigosissimum* prefers rich and fertile soils and is concerned as typical species of floodplain and riparian forests (Winterhoff, 1992). It is red-listed as endangered in Finland (Hyvärinen et al., 2019), and as vulnerable in Leningrad Region (Geltman, 2018). *Mycena renati* develops on the wood of deciduous trees (*Ulmus*, *Quercus*) and is considered as specialized species of broadleaf forests, biologically valuable in the North East of European Russia (Andersson et al., 2009). It is listed as vulnerable in Finland (Hyvärinen et al., 2019) and Leningrad Region (Geltman, 2018).

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## AGARIKOIDINIŲ GRYBŲ RŪŠYS NAUJOS NOVGORODO REGIONUI (RUSIJA)

**Liudmila B. Kalinina**

### Santrauka

Straipsnyje pristatoma trumpa agarikoidinių bazidiomicetų tyrimų Novgorodo regione istorija bei nauji šių grybų radiniai. Pirmą kartą regione aptiktos dvidešimt trys agarikoidinių grybų rūšys, penkios (*Gamundia striatula*, *Mycena erubescens, Mycetinis querceus, Pholiotina brunnea, Sagaranella tylicolor*) yra naujos europinės Rusijos šiaurės vakarinei daliai, trys rūšys (*Baeospora myriadophylla, Entoloma strigosissimum, Mycena renati*) laikomos nykstančiomis.