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ORIGINAL RESEARCH PAPER

New data on aphyllorphoroid fungi (Basidiomycota) in forest-steppe communities of the Lipetsk region, European Russia

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Abstract

The data on 150 species of aphyllorphoroid fungi from the Lipetsk region, Central Russian Upland, European Russia, are presented. The annotated species list based on the herbarium collections (LE, OHHI) and observations in the Galichya Gora Nature Reserve and in the Oleniy Nature Park, including 53 newly identified species in the Lipetsk region, is provided. The species *Acanthophysellum minor* was registered for the first time in Russia. *Athelia nivea* and *Vuilleminia megalospora* were observed only for the second time in the whole country. New data on ecology and distribution of species, such as *Ceratobasidium cornigerum*, *Fibrodontia gossypina*, *Lindtneria panphyliensis*, *Peniophora lilacea*, *Phanerochaete aculeata*, *Phellinus rhamni*, *Sistotrema alboluteum*, *Vararia ochroleuca*, and *Xylodon tuberculatus*, little-known in European Russia, are reported.

Keywords

Agaricomycetes; biodiversity; distribution; nemoral zone; forest-steppe

Introduction

The nontaxonomic group of basidiomycetes, the central focus of our research and historically named the aphyllorphoroid fungi, is characterized by nongilled hymenophores, which include several morphological types, such as polypores, hydroids, corticioids, and clavarioids [1]. They have been confirmed to play a crucial role in dead wood degradation in forest ecosystems (the large number of known species are saproxylic), in addition to participating in trophic chains, mutualistic relationships, and the formation of microhabitats [2,3]. A number of species have been proven good indicators of old-growth forests and can be used as an evidence for establishing a protected area [4,5].

The forest-steppe zone of European Russia is a natural area that has not been sufficiently studied in respect of the species composition and ecological features of the aphyllorphoroid fungi. The Lipetsk region is an area of the forest-steppe zone, which has a rather long history of mycobiota studies primarily devoted to diversity and phenology of macromycetes [6–12]. Moreover, the purposeful research of aphyllorphoroid fungi has been recently initiated in this region [13]. To date, the mycobiota of the region

includes 204 species of aphylophoroid basidiomycetes, of which 14 species are listed in the regional *Red data book* [14].

The aim of our study was to widen knowledge on the species diversity and substrate preferences of aphylophoroid basidiomycetes in forest-steppe communities of the Lipetsk region.

Because most of the territory of the Lipetsk region has been disturbed over the last century, natural forest-steppe communities have been preserved only as local fragments with nature conservation status. Most of these fragments are included in the Galichya Gora Nature Reserve, which is the core of a network of regional protected areas. It occupies an area of 2.3 km² and consists of six separate parts (Fig. 1).

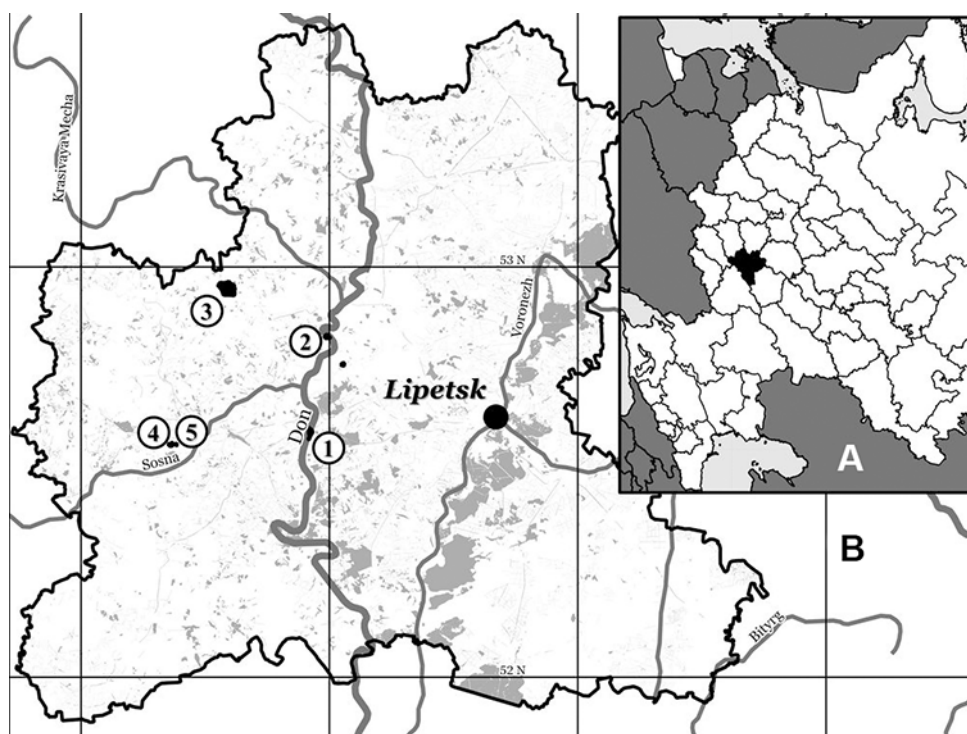


Fig. 1 The locations of territories surveyed. (A) Lipetsk region, Russia. (B) Areas studied: 1 – Morozova Gora protected area; 2 – Plyushchan protected area; 3 – The Oleniy Nature Park; 4 – Voronov Kamen protected area; 5 – Vorgolskoye protected area.

The landscape of the territory is quite heterogeneous. It includes upland steppe and forest zones based on Devonian limestone outcrops (Fig. 2, Fig. 3), rugged by the Bystraya Sosna River valley, its feeders and gullies, and partially by the Don River valley. The reserve is covered with deciduous forest communities formed by *Quercus robur*, *Tilia cordata*, and *Acer platanoides* as dominant species with *Betula pendula* and *Populus tremula* as primary species, and undergrowth, which are typical for the Central Russian Upland [15].

Besides the Galichya Gora Nature Reserve, the Oleniy Nature Park was explored and should be mentioned as one of the largest and youngest protected areas in the Lipetsk region.

Material and methods

Our results are based on field trips to a number of protected areas in the Lipetsk region with forest-steppe vegetation in the Galichya Gora Nature Reserve and the Oleniy Nature Park in September 2016.

Material was collected from five areas according to the classical route method (Fig. 1).



Fig. 2 Dead floor maple forest with lime trees in the Voronov Kamen protected area. Photo by S. Volobuev.

The Morozova Gora protected area is located on the east side of the Don River valley and covers approximately 3 km². The major part of it is a plain (600 m at its widest), which becomes narrower and forms a valley while going from the north to the south. The vegetation comprises fragments of upland oak and birch forests, floodplain willow forests, meadows, and stipe-herb steppe fragments.

The Plyushchan protected area was originally a forest plot on the west side of the Don River valley, rugged by the twisting Plyushchan River from the south to the east, which surrounds the limestone-cliff valley sides. The vegetation cover mostly consists of oak and birch forests, floodplain willow forests, herb-rich steppe fragments, and pine plantings.

Two areas – the Voronov Kamen and the Vorgolskoye – lie on the right side of the Vorgol River. Its valley has a canyon-like appearance and limestone-cliff outcrops are quite usual along the riverside. The typical vegetation cover types for these areas are upland lime tree and oak forests and fragments of floodplain willow forests [10].

The Oleniy Nature Park is protected separately from the Galichya Gora Reserve and is located near the villages of Nikolskoye and Sukhodol in the Krasninskiy District of the Lipetsk region. It covers over 12 km² and most of the territory is occupied by agricultural land, interlaced with gullies and ravines, where different meadow and steppe associations have formed. In addition, ravine oak and birch forests, blackthorn bushes, and shelter belts are widely represented. Some admixtures of garden trees are also found [10].



Fig. 3 Limestone-cliff outcrops on the bank of the Vorgol River. Photo by N. Shakhova.

Abbreviations of localities studied are as follows:

- MG1 – Morozova Gora protected area, 52°36.003' N, 38°55.527' E, postpyrogenic oak forest with maples and hazels;
- MG2 – Morozova Gora protected area, 52°36.102' N, 38°55.196' E, floodplain willow forest with *Acer negundo*;
- P1 – Plyushchan protected area, 52°49.561' N, 38°58.201' E, oak forest with birches;
- P2 – Plyushchan protected area, 52°49.695' N, 38°58.329' E, herb-rich maple forest with oaks and birches;
- P3 – Plyushchan protected area, 52°49.859' N, 38°59.100' E, larch stand;
- P4 – Plyushchan protected area, 52°49.709' N, 38°59.131' E, herb-rich oak forest;
- OP1 – Oleniy Nature Park, 52°57.832' N, 38°36.536' E, herb-rich oak forest with maples and birches;
- OP2 – Oleniy Nature Park, 52°57.959' N, 38°36.403' E, oak forest with maples and hazels;
- OP3 – Oleniy Nature Park, 52°58.020' N, 38°36.438' E, herb-rich oak forest;
- OP4 – Oleniy Nature Park, 52°58.201' N, 38°36.551' E, aspen forest with oaks and birches;
- OP5 – Oleniy Nature Park, 52°57.891' N, 38°36.571' E, herb-rich pine forest;
- OP6 – Oleniy Nature Park, 52°57.412' N, 38°36.496' E, dead floor maple forest with lime trees;
- OP7 – Oleniy Nature Park, 52°58.152' N, 38°36.495' E, aspen forest with hazels;
- VK – Voronov Kamen protected area, 52°34.145' N, 38°21.415' E, dead floor maple forest with lime trees;
- VRG1 – Vorgolskoye protected area, 52°34.380' N, 38°22.059' E, dead floor lime tree forest with aspens, oaks, and maples;
- VRG2 – Vorgolskoye protected area, 52°34.362' N, 38°22.246' E, elm forest with willow and aspens.

The identification of basidiomata specimens was made using the LOMO Micmed-6 and the Carl Zeiss AxioImager A1 light microscopes, and with the standard set of chemical solutions (5% KOH, Melzer's reagent, Cotton Blue).

Results

For each species in the annotated list, references to specimens deposited in the herbarium of Komarov Botanical Institute, St. Petersburg (LE) and the mycological collection in the Khitrovo Herbarium of the Turgenev Oryol State University (OHHI) are provided. The list was organized according to up-to-date taxonomic data [16,17]; each note contained data on the substrate and the type of forest community. Species new to the Lipetsk region were marked with an asterisk. Names of taxa and authors were given according to Index Fungorum (March 27, 2018) [18].

Agaricales

Cyphellaceae

1. *Chondrostereum purpureum* (Pers.) Pouzar – MG1: on fallen log of *Quercus robur*.
2. *Granulobasidium vellereum* (Ellis & Cragin) Jülich – OP1: on fallen log of *Acer platanoides* (LE 313912).

Fistulinaceae

3. *Fistulina hepatica* (Schaeff.) With. – P1: on dead standing trunk of *Quercus robur*.

Niaceae

4. **Dendrothele acerina* (Pers.) P. A. Lemke – VK: on the bark of living *Acer platanoides* (LE 313913, OHHI 1421, OHHI 1422).
5. **Dendrothele alliacea* (Quél.) P. A. Lemke – VRG2: on the bark of living *Ulmus* sp. (LE 313915).

Physalacriaceae

6. **Cylindrobasidium laeve* (Pers.) Chamuris – MG2, OP6: on fallen logs of *Acer platanoides* and *Salix* sp. (LE 313940, OHHI 1383, OHHI 1395).

Pterulaceae

7. *Radulomyces confluens* (Fr.) M. P. Christ. – OP2, P1, VK, VRG1: on fallen branches and logs of *Quercus robur* and *Populus tremula* (LE 313869, OHHI 1378, OHHI 1401, OHHI 1409).
8. *Radulomyces molaris* (Chaillet ex Fr.) M. P. Christ. – OP2, OP6, P1: on fallen branches and logs of *Acer platanoides* and *Quercus robur* and on dead standing trunk of *Corylus avellana* (LE 313882, LE 313966, OHHI 1380, OHHI 1394).

Schizophyllaceae

9. **Henningsomyces candidus* (Pers.) Kuntze – P3: on fallen log of *Betula pendula* (LE 313925).
10. *Schizophyllum amplum* (Lév.) Nakasone – MG2: on fallen branch of *Salix* sp. (LE 313917).
11. *Schizophyllum commune* Fr. – P2: on dead standing trunk and fallen log of *Prunus padus* and *Quercus robur*.

Stephanosporaceae

12. *Lindtneria panphyliensis* Bernicchia & M. J. Larsen – OP1: on fallen bark of *Quercus robur* (LE 313890).

Atheliales

Atheliaceae

13. *Athelia acrospora* Jülich – OP2: on fallen branch of *Betula pendula* (LE 313856).
14. *Athelia arachnoidea* (Berk.) Jülich – MG2, OP2, P4, VRG1: on fallen and dead branches of *Acer negundo*, *A. platanoides*, and *Quercus robur* (LE 313859, OHHI 1386, OHHI 1394).
15. **Athelia nivea* Jülich – OP6: on fallen log of *Acer platanoides* (LE 313976).

16. *Leptosporomyces mutabilis* (Bres.) Krieglst – P1: on fallen log of *Betula pendula* (LE 313971).

Auriculariales

Auriculariaceae

17. *Auricularia mesenterica* (Dicks.) Pers. – OP6: on fallen branch of *Acer platanoides*.

Boletales

Coniophoraceae

18. *Coniophora puteana* (Schumach.) P. Karst. – MG1, OP1, VK: on fallen logs of *Acer platanoides*, *Betula pendula* and *Populus tremula* and on the stembase of *Quercus robur* (LE 314004, LE 314008, OHHI 1368, OHHI 1423).

Cantharellales

Botryobasidiaceae

19. *Botryobasidium candicans* J. Erikss. – OP1: on fallen log of *Betula pendula* (LE 313865).
20. *Botryobasidium laeve* (J. Erikss.) Parmasto – MG1, OP1, VK: on fallen branches of *Acer platanoides* and *Betula pendula* and on fallen burnt log of *Quercus robur* (LE 313878, LE 313879, LE 313957, OHHI 1342, OHHI 1351, OHHI 1391, OHHI 1403).
21. **Botryobasidium pruinautum* (Bres.) J. Erikss. – MG1: on fallen burnt log of *Quercus robur* (LE 313995).

Ceratobasidiaceae

22. **Ceratobasidium cornigerum* (Bourdot) D. P. Rogers – P3: on fallen log of *Larix* sp. (LE 313934, OHHI 1390).

Hydnaceae

23. *Clavulina cinerea* (Bull.) J. Schröt – OP1: on soil (LE 313866).
24. **Sistotrema alboluteum* (Bourdot & Galzin) Bondartsev & Singer – VRG1: on fallen log of *Quercus robur* on forest floor (LE 313914).
25. **Sistotrema brinkmannii* (Bres.) J. Erikss. – OP6, P2: on fallen log of *Acer platanoides* and on dead basidiome of *Fomes fomentarius* (LE 313923, OHHI 1393).
26. **Sistotrema oblongisporum* M. P. Christ. & Hauerslev – P3: on fallen log of *Betula pendula* (LE 313983).
27. *Sistotrema octosporum* (J. Schröt. ex Höhn. & Litsch.) Hallenb. – OP2: on dead standing trunk of *Corylus avellana* (LE 313888).
28. *Sistotrema radulooides* (P. Karst.) Donk – OP1, P3: on fallen logs of *Betula pendula* and *Populus tremula* (LE 313897, LE 314012, OHHI 1358).
29. *Sistotrema sernanderi* (Litsch.) Donk – OP1: on fallen log of *Betula pendula* (LE 313900, LE 314022).

Corticiales

Corticaceae

30. **Marchandiomyces quercinus* (J. Erikss. & Ryvar den) D. Hawksw. & A. Henrici – VRG1: on fallen branch of *Quercus robur* (LE 314005).

Punctulariaceae

31. *Punctularia strigosozonata* (Schrad.) Parmasto – OP4: on dead standing trunk of *Populus tremula* (LE 313903).

Vuilleminiaceae

32. *Vuilleminia comedens* (Nees) Maire – P2, P4: on fallen log of *Betula pendula* and on dead standing trunk of *Corylus avellana* (LE 313927, OHHI 1398).
33. *Vuilleminia coryli* Boidin, Lanq. & Gilles – OP1: on fallen branches of *Betula pendula* and *Quercus robur* (LE 313870, OHHI 1339).
34. **Vuilleminia megalospora* Bres. – P1: on fallen branch of *Quercus robur* (LE 313963).

Gomphales

Lentariaceae

35. **Hydnocristella himantia* (Schwein.) R. H. Petersen – P4, VRG1: on dead standing trunk and fallen log of *Salix* sp. and on fallen log of *Quercus robur* (LE 313951, LE 313954, OHHI 1362).

Hymenochaetales

Hymenochaetaceae

36. *Fomitiporia punctata* (P. Karst.) Murrill – P4: on fallen log of *Salix* sp. (LE 314002).
37. *Fomitiporia robusta* (P. Karst.) Fiasson & Niemelä – P4: on dead standing trunk of *Quercus robur*.
38. **Fuscoporia contigua* (Pers.) G. Cunn. – OP7, VK: on fallen logs, branches and dead standing trunk of *Acer platanoides*, *Prunus padus*, *Tilia cordata* (LE 313930, OHHI 1398).
39. *Hymenochaete fuliginosa* (Pers.) Lév. – OP2: on dry branch of *Quercus robur* (LE 313874).
40. *Inocutis rheades* (Pers.) Fiasson et Niemelä – OP4: on dead standing trunk of *Populus tremula*.
41. *Mensularia radiata* (Sowerby) Lázaro Ibiza – OP7: on living stem of *Corylus avellana* (LE 313895).
42. **Phellinus rhamni* (Bondartseva) H. Jahn – P4: on dead standing trunk of *Frangula alnus* (LE 314014).
43. *Phylloporia ribis* (Schumach.) Ryvarden – P3: on living stem of *Euonymus verrucosus* (LE 314015).
44. *Trichaptum bifforme* (Fr.) Ryvarden – P2: on fallen log of *Betula pendula*.

Oxyporaceae

45. *Oxyporus obducens* (Pers.) Donk – P4, VRG2: on fallen logs of *Populus tremula* and *Salix* sp. (LE 313981, LE 313982).
46. *Oxyporus populinus* (Schumach.) Donk – P3, P4, OP6: on fallen logs of *Populus tremula* and *Salix* sp. (LE 313990, LE 313993, OHHI 1363).

Rickenellaceae

47. **Peniophorella praetermissa* (P. Karst.) J. Erikss. & Å. Strid – P3, VRG1: on fallen branches and logs of *Quercus robur* and *Larix* sp. (LE 313994, LE 314000).
48. *Peniophorella pubera* (Fr.) P. Karst. – OP1, OP6, P1, P2, VK: on fallen logs, branches and fallen bark of *Acer platanoides*, *Betula pendula*, *Corylus avellana*, *Quercus robur* and on dead basidiome of *Fomes fomentarius* (LE 313889, LE 313891, LE 313997, LE 313998, LE 313999, OHHI 1382, OHHI 1383).

Schizoporaceae

49. *Hyphodontia arguta* (Fr.) J. Erikss. – OP2, P4: on fallen log and branches of *Acer platanoides* and *Tilia cordata* (LE 313860, OHHI 1399).
50. **Kneiffiella barba-jovis* (Bull.) P. Karst. – P2, P3: on fallen logs of *Betula pendula* and *Larix* sp. (LE 313919, LE 313920, OHHI 1356, OHHI 1357, OHHI 1389).
51. *Lyomyces crustosus* (Pers.) P. Karst. – MG2, OP1, OP2, P3, VK, VRG1: on dead standing trunks, fallen logs, branches of *Acer negundo*, *A. platanoides*, *Euonymus verrucosus*, *Quercus robur*, *Salix* sp. (LE 313872, LE 313935, LE 313936, OHHI 1340, OHHI 1341, OHHI 1385, OHHI 1388, OHHI 1400, OHHI 1411, OHHI 1420).

52. **Lyomyces erastii* (Saaren. & Kotir.) Hjortstam & Ryvarde – MG2, P2: on fallen branch of *Betula pendula* and on dead branch of *Acer negundo* (LE 313938, LE 313941).
53. *Lyomyces sambuci* (Pers.) P. Karst. – MG2, OP6, VK, VRG1: on fallen branches and logs, on dead standing trunk of *Acer platanoides*, *Quercus robur*, *Prunus padus*, *Salix* sp. and on dead Apiaceae grass (LE 314018, LE 314019, LE 314020, LE 314021, OHHI 1387, OHHI 1392, OHHI 1396, OHHI 1410, OHHI 1425).
54. *Xylodon flaviporus* (Berk. & M. A. Curtis ex Cooke) Riebesehl & Langer – P2: on fallen log of *Betula pendula* (LE 313945, OHHI 1414).
55. *Xylodon paradoxus* (Schrad.) Chevall. – P1: on fallen branch of *Quercus robur* (LE 313989).
56. **Xylodon pruni* (Lasch) Hjortstam & Ryvarde – OP6: on fallen branch of *Acer platanoides* (LE 313996).
57. **Xylodon quercinus* (Pers.) Gray – MG2: on fallen branch of *Quercus robur* (LE 314009).
58. *Xylodon raduloides* Riebesehl & Langer – MG2, OP1: on fallen log and branch of *Quercus robur* and *Salix* sp. (LE 313896, LE 314013).
59. **Xylodon spathulatus* (Schrad.) Kuntze – OP6: on fallen branch of *Acer platanoides* (LE 314026).
60. *Xylodon tuberculatus* (Kotir. & Saaren.) Hjortstam – P4, OP1: on fallen logs and branches of *Betula pendula*, *Quercus robur*, and *Salix* sp. (LE 313905, LE 314039, OHHI 1392).

Polyporales

Cerrenaceae

61. *Cerrena unicolor* (Bull.) Murrill – OP1: on fallen branch of *Betula pendula* (LE 314041, OHHI 1366).

Dacrybolaceae

62. *Postia alni* Niemelä & Vampola – OP2, VRG1: on fallen logs of *Acer platanoides* and *Prunus padus* (LE 313858, OHHI 1373, OHHI 1407).
63. **Postia balsamea* (Peck) Jülich – VRG1: on fallen log of *Pyrus* sp. (LE 313918).
64. *Postia lactea* (Fr.) P. Karst. – OP1, VK: on fallen branches and logs of *Acer platanoides*, *Corylus avellana*, and *Salix* sp. (LE 313877, LE 314030, LE 314031, OHHI 1396, OHHI 1397).
65. **Postia stiptica* (Pers.) Jülich – OP6: on fallen log of *Acer platanoides* (LE 314027).
66. *Skeletocutis nivea* (Jungh.) Jean Keller – OP1, OP6, VK: on fallen branches of *Prunus padus*, *Quercus robur* and on dead standing trunk of *Acer platanoides* (LE 313884, LE 313978, OHHI 1419).

Fomitopsidaceae

67. *Antrodia minuta* Spirin – OP2, VRG1: on fallen logs of *Acer platanoides* and *Quercus robur* (LE 313881, LE 313965).
68. *Antrodia sinuosa* (Fr.) P. Karst. – OP4: on fallen log of *Acer platanoides* (LE 313902).
69. **Antrodia xantha* (Fr.) Ryvarde – OP1: on fallen log of *Acer platanoides* (LE 314047).
70. *Daedalea quercina* (L.) Pers. – MG1: on fallen log of *Quercus robur* (LE 314006, OHHI 1350).
71. *Fomitopsis betulina* (Bull.) B. K. Cui, M. L. Han & Y. C. Dai – P2: on fallen log of *Betula pendula*.
72. *Fomitopsis pinicola* (Sw.) P. Karst. – VRG1: on fallen log and dead standing trunk of *Quercus robur* and *Tilia cordata*.

Hyphodermataceae

73. **Hyphoderma mutatum* (Peck) Donk – OP6, P1, VRG1: on fallen logs and branches of *Acer platanoides* and *Quercus robur* and on dead standing trunk of *Populus tremula* (LE 313972, LE 313974, LE 313977, OHHI 1397, OHHI 1404).

74. **Hyphoderma occidentale* (D. P. Rogers) Boidin & Gilles – P1: on fallen branch of *Quercus robur* (LE 314031).
75. *Hyphoderma setigerum* (Fr.) Donk – MG2, OP1, OP2, OP4, P1, P2: on fallen logs and branches of *Acer platanoides*, *Betula pendula*, *Quercus robur*, and *Corylus avellana* and on dead standing trunk of *Populus tremula* (LE 313899, LE 313901, LE 314023, LE 314024, OHHI 1345, OHHI 1346, OHHI 1347, OHHI 1377, OHHI 1380, OHHI 1385).
76. **Hyphoderma transiens* (Bres.) Parmasto – OP6: on fallen log of *Acer platanoides* (LE 314033).

Irpicaceae

77. *Byssomerulius corium* (Pers.) Parmasto – MG2, VRG1: on fallen logs and dead branches of *Acer negundo* and *Salix* sp. (LE 313932, LE 313933, OHHI 1381, OHHI 1388).
78. *Ceriporia bresadolae* (Bourdot & Galzin) Donk – OP5: on fallen log of *Pinus sylvestris* (LE 313863).
79. *Ceriporia purpurea* (Fr.) Donk – OP2, P4: on fallen logs of *Quercus robur* (LE 313893, OHHI 1359, OHHI 1391).
80. **Ceriporia viridans* (Berk. & Broome) Donk – VK: on fallen branch of *Acer platanoides* (LE 314043).
81. *Efibula tuberculata* (P. Karst.) Zmitr. & Spirin – OP3, P4: on fallen branches of *Quercus robur* and *Sorbus aucuparia* (LE 313911, LE 314037, LE 314038).
82. *Emmia latemarginata* (Durieu & Mont.) Zmitr., Spirin & Malysheva – OP6: on fallen log of *Acer platanoides* (LE 313959).
83. *Gloeoporus dichrous* (Fr.) Bres. – OP6: on fallen branch of *Corylus avellana*.
84. **Gloeoporus pannocinctus* (Romell) J. Erikss. – P1, VRG2: on fallen log of *Populus tremula* and on dead basidiome of *Fomes fomentarius* (LE 313988, LE 313992).
85. *Irpex lacteus* (Fr.) Fr. – VRG1: on fallen branch of *Fraxinus excelsior* (LE 313956).

Meruliaceae

86. *Phlebia radiata* Fr. – OP7, P2, VK: on fallen logs of *Acer platanoides*, *Betula pendula*, and *Populus tremula* and on living stem of *Corylus avellana* (LE 313894, LE 314010, OHHI 1386, OHHI 1402).
87. *Phlebia rufa* (Pers.) M. P. Christ. – OP6, VRG1: on fallen branch of *Acer platanoides* and on dead standing trunk of *Populus tremula* (LE 314017, OHHI 1405).
88. *Phlebia tremellosa* (Schrad.) Nakasone & Burds. – P2: on fallen log of *Betula pendula* (LE 314034).

Phanerochaetaceae

89. *Bjerkandera adusta* (Willd.) P. Karst. – MG1: on the stembase of *Betula pendula*.
90. *Bjerkandera fumosa* (Willd.) P. Karst. – MG2, VRG1: on fallen log of *Populus tremula* and on living tree of *Acer negundo* (LE 313949).
91. *Donkia pulcherrima* (Berk. & M. A. Curtis) Pilát – MG1: on fallen log of *Betula pendula* (LE 314001).
92. *Phanerochaete aculeata* Hallenb. – OP1, OP4: on dead basidiomes of *Fomes fomentarius* on dead standing stem of *Betula pendula* (LE 313857, LE 313861).
93. **Phanerochaete cumulodentata* (Nikol.) Parmasto – P1, P4: on fallen branches of *Quercus robur* (LE 313937, LE 313939, OHHI 1384).
94. **Phanerochaete laevis* (Fr.) J. Erikss. & Ryvarden – P2, P3, VRG1: on fallen logs and branches of *Quercus robur* and *Larix* sp. (LE 313958, LE 313960, OHHI 1384).
95. **Phanerochaete livescens* (P. Karst.) Volobuev & Spirin – P1: on fallen log of *Quercus robur* (LE 313962).
96. **Phanerochaete velutina* (DC.) P. Karst. – P4: on fallen branch of *Tilia cordata* (LE 314042).
97. *Phlebiopsis ravenelii* (Cooke) Hjortstam – OP1: on fallen log of *Corylus avellana* (LE 313898).
98. *Porostereum spadiceum* (Pers.) Hjortstam & Ryvarden – MG1, P2: on fallen burnt log of *Quercus robur* and on fallen bark of deciduous tree (LE 314025, LE 314030).

Podoscyphaceae

99. **Hypochnicium wakefieldiae* (Bres.) J. Erikss. – OP2, P1: on dead standing trunk and the stembase of dead *Quercus robur* (LE 314046, OHHI 1381).

Polyporaceae

100. *Daedaleopsis confragosa* (Bolton) J. Schröt. – MG2, P2: on fallen logs of *Betula pendula* and *Salix* sp. (LE 313929, OHHI 1382, OHHI 1387).
 101. *Daedaleopsis tricolor* (Bull.) Bondartsev & Singer – P2: on fallen log of *Betula pendula* (LE 314035).
 102. *Datronia mollis* (Sommerf.) Donk – OP1: on fallen branch of *Betula pendula* (LE 313967).
 103. *Fomes fomentarius* (L.) Fr. – MG2, OP1, OP4, P1, P2, VRG1: on fallen logs of *Acer platanoides* and *Betula pendula*.
 104. *Polyporus alveolaris* (DC.) Bondartsev & Singer – VRG2: on fallen log of *Populus tremula* (LE 313916, OHHI 1415).
 105. *Polyporus brumalis* (Pers.) Fr. – OP6: on fallen branch of *Acer platanoides* (LE 313924, OHHI 1390).
 106. *Trametella trogii* (Berk.) Domański – OP1: on fallen log of *Populus tremula* (LE 314036).
 107. *Trametes ochracea* (Pers.) Gilb. & Ryvarden – P1: on fallen log of *Betula pendula*.
 108. *Trametes versicolor* (L.) Lloyd – OP3: on fallen log of *Prunus padus*.

Steccherinaceae

109. **Antrodiella faginea* Vampola & Pouzar – P1: on fallen branch of *Quercus robur* (LE 313942).
 110. **Antrodiella pallescens* (Pilát) Niemelä & Miettinen – OP7: on dead tree of *Corylus avellana* (LE 313986).
 111. **Antrodiella romellii* (Donk) Niemelä – VRG1: on fallen branch of *Quercus robur* (LE 314016).
 112. *Junghuhnia nitida* (Pers.) Ryvarden – OP1, OP4, P2, VK, VRG1: on fallen logs and branches of *Acer platanoides*, *Betula pendula*, *Fraxinus excelsior*, and *Quercus robur* (LE 313883, LE 313973, LE 313975, OHHI 1343, OHHI 1344, OHHI 1367).
 113. *Metuloidea fragrans* (A. David & Tortic) Miettinen – MG1, OP1, VRG1: on fallen branches and logs and on living stem of *Betula pendula*, *Corylus avellana*, and *Prunus padus* (LE 313946, LE 313948, OHHI 1348, OHHI 1369, OHHI 1372).
 114. **Metuloidea murashkinskyi* (Burt) Miettinen & Spirin – P4: on fallen logs of *Salix* sp. (LE 313969, LE 313970, OHHI 1364).
 115. **Steccherinum bourdotii* Saliba & A. David – OP1: on fallen branch of *Quercus robur* (LE 313922).
 116. *Steccherinum fimbriatum* (Pers.) J. Erikss. – OP1, P1, VK, VRG1: on fallen branches of *Acer platanoides* and *Quercus robur* (LE 313944, LE 313947, OHHI 1370, OHHI 1375).
 117. *Steccherinum ochraceum* (Pers.) Gray – MG1, OP1, OP7, P2, VRG1: on fallen branches and logs of *Acer platanoides*, *Betula pendula*, *Corylus avellana*, *Populus tremula*, and *Quercus robur* (LE 313887, LE 313984, LE 313987, LE 313991, OHHI 1352, OHHI 1353, OHHI 1355, OHHI 1361, OHHI 1365, OHHI 1371, OHHI 1374).

Xenasmataceae

118. *Phlebiella tulasnelloidea* (Höhn. & Litsch.) Oberw. – OP1: on dead standing trunk and fallen log of *Acer platanoides* and *Betula pendula* (LE 313906, LE 313909).
 119. *Phlebiella vaga* (Fr.) P. Karst. – OP2, VK: on fallen bark and log of *Acer platanoides* and *Quercus robur* (LE 313907, OHHI 1399).

Russulales

Hericiaceae

120. *Hericium coralloides* (Scop.) Pers. – MG1: on fallen log of *Betula pendula* (LE 313931, OHHI 1349).

121. *Laxitextum bicolor* (Pers.) Lentz – P4, VRG1: on dead standing trunk of *Populus tremula* and on fallen log of *Quercus robur* (LE 313921).

Peniophoraceae

122. *Peniophora cinerea* (Pers.) Cooke – OP2, P4, VRG1: on fallen branches of *Acer platanoides* and *Quercus robur* (LE 313867, OHHI 1376, OHHI 1408).
 123. **Peniophora incarnata* (Pers.) P. Karst. – OP6, P1: on fallen branches of *Acer platanoides* and *Betula pendula* (LE 313953, LE 313955).
 124. **Peniophora lilacea* Bourdot & Galzin – VK: on fallen branch of *Acer platanoides* (LE 313961).
 125. **Peniophora nuda* (Fr.) Bres. – P1, P2: on fallen and dead branches of *Acer platanoides* and *Prunus padus* (LE 313979, LE 313980).
 126. *Peniophora quercina* (Pers.) Cooke – P1, P4: on fallen log and branches of *Quercus robur* (LE 314007, OHHI 1360, OHHI 1393).
 127. **Peniophora violaceolivida* (Sommerf.) Massee – MG2, OP1: on dead and fallen branches of *Acer negundo* and *Betula pendula* (LE 313908, LE 314045, OHHI 1337).
 128. **Vararia ochroleuca* (Bourdot & Galzin) Donk – P4: on fallen log of *Quercus robur* (LE 313985).

Stereaceae

129. **Acanthophysellum minor* (Pilát) Sheng H. Wu, Boidin & C. Y. Chien – VK: on hanging dead trunk of *Pyrus* sp. (LE 313964).
 130. *Stereum gausapatum* (Fr.) Fr. – MG1: on fallen log of *Quercus robur*.
 131. *Stereum hirsutum* (Willd.) Pers. – MG1, P1: on fallen logs and branches of *Quercus robur* (LE 313952, OHHI 1354).
 132. *Stereum subtomentosum* Pouzar – MG1, VRG1: on fallen log of *Quercus robur* (LE 314029).

Sebacinales

Sebacinaceae

133. *Sebacina incrustans* (Pers.) Tul. & C. Tul. – OP6: on dead standing trunk of *Tilia cordata* (LE 313876).

Thelephorales

Thelephoraceae

134. *Tomentella badia* (Link) Stalpers – OP1: on fallen branches of *Betula pendula* and *Corylus avellana* (LE 313862, LE 313910).
 135. *Tomentella bryophila* (Pers.) M. J. Larsen – OP2, P1: on fallen branches of *Acer platanoides* and *Quercus robur* (LE 313864, OHHI 1379).
 136. **Tomentella crinalis* (Fr.) M. J. Larsen – OP1: on fallen log of *Betula pendula* (LE 313871).
 137. *Tomentella ferruginea* (Pers.) Pat. – OP2: on fallen branch of *Corylus avellana* (LE 313873).
 138. *Tomentella lilacinogrisea* (Link) Pers. – OP1: on fallen log of *Betula pendula* (LE 313880).
 139. *Tomentella punicea* (Alb. & Schwein.) J. Schröt. – OP1, P4, VRG1: on fallen branches and burnt logs of *Quercus robur* (LE 313892, LE 314003, OHHI 1413, OHHI 1416, OHHI 1418).
 140. **Tomentella radiosa* (P. Karst.) Rick – P1: on fallen burnt log of *Betula pendula* (LE 314011).
 141. **Tomentella stuposa* (Link) Stalpers – P1, VRG1: on fallen branch and log of *Quercus robur* (LE 314028, OHHI 1424).
 142. *Tomentella sublilacina* (Ellis & Holw.) Wakef. – OP2, P1, P4: on fallen branches and log of *Acer platanoides*, *Quercus robur*, and *Corylus avellana* (LE 313904, LE 314032, OHHI 1395).

143. **Tomentella umbrinospora* M. J. Larsen – P1, VRG1: on fallen burnt logs of *Betula pendula* and *Quercus robur* (LE 314040, LE 314044).

Trechisporales

Hydnodontaceae

144. **Fibrodontia gossypina* Parmasto – VK: on fallen log of *Acer platanoides* (LE 313950, OHHI 1412).
145. *Sistotremastrum niveocremeum* (Höhn. & Litsch.) J. Erikss. – OP6, OP7: on fallen logs of *Acer platanoides* and *Populus tremula* (LE 313885, LE 313886).
146. **Trechispora cohaerens* (Schwein.) Jülich & Stalpers – OP1, P2: on fallen logs of *Betula pendula* and *Quercus robur* and on dead basidiome of *Fomes fomentarius* (LE 313926, LE 313928, OHHI 1389).
147. *Trechispora confinis* (Bourdot & Galzin) Liberta – OP2: on dead branch and fallen log of *Quercus robur* (LE 313868, OHHI 1338).
148. **Trechispora farinacea* (Pers.) Liberta – VK: on fallen branch of *Acer platanoides* (LE 313943).
149. *Trechispora hymenocystis* (Berk. & Broome) K. H. Larss. – OP1: on fallen log of *Quercus robur* (LE 313875).
150. **Trechispora mollusca* (Pers.) Liberta – P4: on fallen branch of *Quercus robur* (LE 313968, OHHI 1417).

Discussion

A total of 150 species of aphylophoroid fungi were listed for the Lipetsk region, including 53 species registered for the region for the first time and *Acanthophysellum minor* as a new species in Russia. According to Bernicchia and Gorjón [19], *A. minor* is also known from the Mediterranean Basin (Spain, Portugal), Central Europe (Croatia), and the Caucasus (Iran).

Among the species new to the region, attention was particularly attracted by *Athelia nivea* and *Vuilleminia megalospora*, which were observed only for the second time in Russia. Both species were known prior to this study only from the Leningrad region [20,21]. The species *Athelia nivea* is generally considered a member the *A. epiphylla* species complex, but is distinguished from other species of the complex (e.g., *A. epiphylla* s. str., *A. ovata*) by frequent clamps on subicular hyphae. The known distribution of *A. nivea* in Europe covers the Czech Republic, Germany, Slovakia, Sweden, and the United Kingdom [22]. Our finding of *Vuilleminia megalospora* on *Quercus robur* from the forest-steppe zone of European Russia is congruent with available data on occurrences and ecological requirements of the species being found on hardwoods like *Quercus* and *Crataegus* in Croatia, France, Greece, Italy, Macedonia, Slovakia, Spain, and Iran [19,23]. Two other species have been found for the second time within the European part of Russia, in particular, *Fibrodontia gossypina*, known from the Komi Republic [24], and *Sistotrema alboluteum*, reported from the Nizhny Novgorod region [25]. Both species have a widespread but scattered distribution in Europe [19,26]. *Ceratobasidium cornigerum*, *Peniophora lilacea*, *Xylodon tuberculatus* are also little known in the European Russia, and each species has been recorded from no more than three localities [27].

Other remarkable records of aphylophoroid fungi revealed by this study were *Phellinus rhamnii* and *Vararia ochroleuca*. *Phellinus rhamnii* found on dry standing stems of *Frangula alnus* was registered for the second time in the Central Russian Upland after collection from the Bryansk Region [28]. This is a diagnostic species of forest communities in Central and Eastern Europe associated primarily with some members of the family Rhamnaceae. The recording of *Vararia ochroleuca* is also the second on the territory of the Central Russian Upland, where the species was collected earlier from the Oryol region [29].

The peculiarity of the biota of the revealed aphylophoroid fungi was characterized by the findings of some species exclusively associated with broad-leaved trees and

distributed in nemoral zone. Such species as *Lindtneria panphyliensis* and *Phanerochaete aculeata* listed particularly for the Oleniy Nature Park [13], were known previously in European Russia only from the forest-steppe communities of the Oryol region [30].

The maximum species richness was noted for the genera *Hyphodontia* s. l. (including *Kneiffiella*, *Lyomyces*, *Xylodon*) (12 species) and *Tomentella* (10 species).

The highest number of aphylloroid fungi species was found on the woods of *Quercus robur*, *Acer platanoides*, and *Betula pendula* (Fig. 4). Substrate units occupied by several species of fungi were revealed simultaneously not only among large-scale forest-forming trees, but also among less frequently found substrates, for instance, dead basidiomata of polypores. In total, five species (*Gloeoporus pannocinctus*, *Peniophorella pubera*, *Phanerochaete aculeata*, *Sistotrema brinkmannii*, *Trechispora cohaerens*) were collected from dead basidiomata of *Fomes fomentarius*.

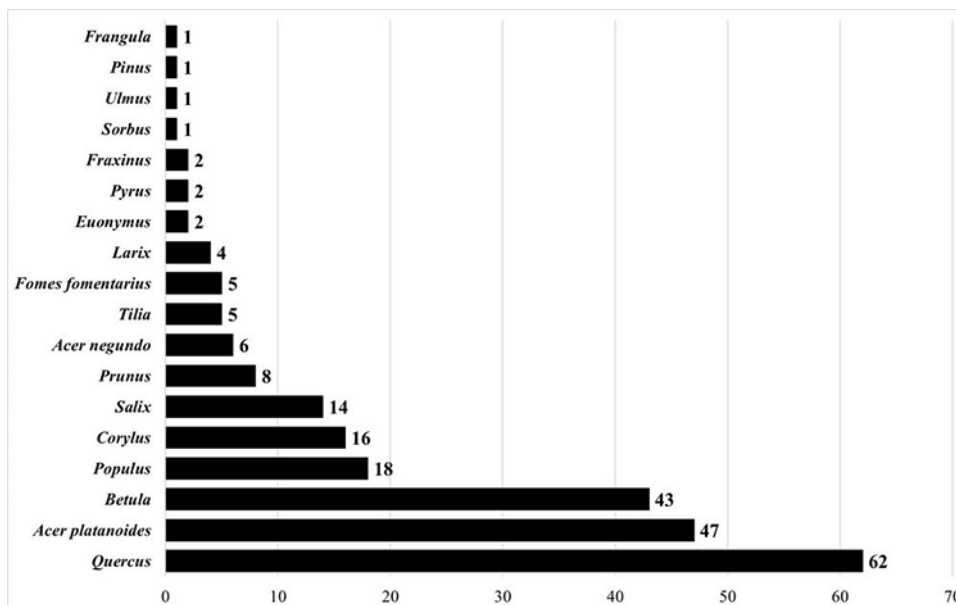


Fig. 4 The number of species of aphylloroid fungi registered on each substrate type.

New localities for three species of aphylloroid fungi protected in the Lipetsk region were registered during the mycological survey: *Hericium coralloides*, which has an official conservation status in the Lipetsk region [14], as well as *Donkia pulcherrima*, and *Metuloidea fragrans* are included to the monitoring list and recommended for observational studies on their distribution and ecological features in the region.

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