БИОРАЗНООБРАЗИЕ, СИСТЕМАТИКА, ЭКОЛОГИЯ

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NEW AND RARE FUNGI ON ALIEN WOODY PLANTS IN SVERDLOVSK REGION (THE MIDDLE URALS, RUSSIA)

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A groundbreaking study has documented 28 species of phytopathogenic and saprobic fungi, belonging to *Ascomycota* and *Basidiomycota* divisions, on alien trees and shrubs in Sverdlovsk Region for the first time. In addition, 14 rare species – each with only two to four previous sightings in the region – were identified. Notably, four species – *Cheirospora botryospora*, *Homortomyces tamaricis*, *Lophomerum rhododendri*, and *Pyrenopeziza lonicerae* – were recorded in Russia for the first time. The surveyed fungi were found growing on 34 woody plant species, 27 of which occur outdoors while the remaining seven are restricted to greenhouse environments. The study also sheds light on dangerous invasive phytopathogenic fungi in the region, including *Biscogniauxia mediterranea* and *Entoleuca mammata*. Additionally, the invasive species *Hymenoscyphus fraxineus*, recently discovered in Sverdlovsk Region, has been recorded at a new site. The ITS1–5.8S–ITS2 sequence of *H. fraxineus* collected at this location corresponds to the standard East Asian sequence variant. This suggests that local populations of *H. fraxineus* in Sverdlovsk Region may not originate from Europe but rather from East Asia.

Keywords: alien species, *Ascomycota*, *Basidiomycota*, biodiversity, fungal distribution, invasion, plant pathogens

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INTRODUCTION

Fungal diversity in Sverdlovsk Region has been under investigation for over a century, with foundational studies carried out by researchers such as P.V. Syuzev (1898, 1911), N.A. Naumov (1915), Z.A. Demidova (1925, 1970), and N.T. Stepanova-Kartavenko (1967), among others. However, focused research on alien and invasive fungal species in the region has only gained momentum in the last few decades (Shiryaev, 2009; Shiryaev et al., 2010; Shiryaev, Stavishenko, 2011). This study represents the 11th publication in a series dedicated to identifying fungal species presented on alien woody plants in the Middle Urals (Bulgakov, Shiryaev, 2021, 2022; Shiryaev et al., 2021, 2022a, 2022b, 2023a, 2023b, 2023c, 2024; Shiryaev, Kiseleva, 2023). The primary objective is to document newly observed and rare (with one to four previous sightings) species colonizing alien woody plants within the region.

MATERIALS AND METHODS

Materials. The referred species were gathered by A. Shiryaev and T. Bulgakov during the fieldwork in 2015–2025 at different sites within Sverdlovsk Region. In addition, the specimens of phytopathogenic fungi provided in recent years by botanical gardens staff, phytodesigners, and amateurs (N. Azalova, V. Domrachev, P. Martushev, V. Zavorukhin) were studied. This material is stored at the Museum of the Institute of Plant and Animal Ecology (SVER). A number of specimens from the SVER were examined. There are collections of O. Clerc, P. Syuzev, A. Kazanskiy, Z. Demidova, A. Sirko, N. Stepanova, S. Kadochnikov, N. Ushakova, S. Ljashko, B. Panov, and I. Tikhonova, made in the period from the beginning of the 20th century to the present day.

Morphological study. All specimens were examined under light microscope Leica DM 2000. The microscopic features were studied from the material

mounted in distilled water, 10% NH_4OH, 5% KOH, Melzer's reagent and 1% Congo Red in concentrated NH_4OH.

Special key-books and monographs were used for identification of the fungal species (Kuprevich, Ulyanishchev, 1975; Ulyanishchev, 1978; Teterevnikova-Babayan, 1987; Butin, 1989; Braun, Melnik, 1997; Ellis, Ellis, 1997; Braun, 1998; Karatygin, 2002; Braun, Cook, 2012; Knudsen, Vesterholt, 2012; Ryvarden, Melo, 2014; Blagoveshchenskaya, 2015), as well as some additional publications devoted to the study and taxonomical revision of the some particular fungal taxa and new species descriptions (Hyde et al., 2018; Senwanna et al., 2019; Crous et al., 2020) and open global database "Fungal Databases: U.S. National Fungus Collections" (Farr, Rossman, 2024). Fungal names are given according to the Index Fungorum (2025) online database.

The host plant species were identified by the keybook "Keys to the trees and shrubs species of the Urals" (Mamaev, 2000); the plant species are given according to the open nomenclatural database "Plant of the World Online" (POWO, 2025). Some introduced exotic plant species in the collections of the Botanical garden were determined according to the personal data of researchers of the Botanical Garden of the Ural Branch of the Russian Academy of Sciences.

The following abbreviations are used in the list: new species for Russia are marked with an exclamation mark; new species for Sverdlovsk Region are marked with an asterisk; Ekb – Ekaterinburg City; BCD – Botanical City District; BG UrB RAS – Botanical Garden of the Ural Branch of the Russian Academy of Sciences; BG UFU – Botanical Garden of the Ural Federal University; DP – Dendrarium at Pervomayskaya street; D8 – Dendrarium at 8 March street; MCP – Maykovskiy Central Park of Ekaterinburg city; VG – Prof. L.I. Vigorov Medicinal crops garden.

DNA extraction, amplification, and sequencing. One apothecium from the specimen tentatively assigned to *Hymenoscyphus fraxineus* was used for the DNA extraction. DNA extraction was performed using the MagnoPrime PHYTO reagent kit (NextBIO) according to the manufacturer's instructions.

The ITS1–5.8S–ITS2 region of rDNA was amplified with the universal primer pair ITS5/ITS4 (White et al., 1990). PCR reaction was carried out under the following conditions: initial denaturation for 3 min at 95°C, 40 cycles (denaturation for 30 s at 95°C, primers annealing for 30 s at 52°C, extend DNA for 30 s at 72°C), final extension for 7 min at 72°C. PCR products intended for sequencing were purified using the commercial GeneJET Genomic DNA Purification Kit (Thermo Scientific). The sequencing reaction was performed using BigDye Terminator v. 3.1 Cycle Sequencing Kit reagents (Applied Biosystems) according to the manufacturer's instructions, followed by fragment separation on an Applied Biosystems 3500 Genetic Analyzer. Sequencing of the PCR products was performed with the same primer pairs used for PCR amplification.

Newly generated sequence was deposited in GenBank (PX251630). Molecular studies were performed at the All-Russian Plant Quarantine Center (VNIIKR).

Phylogenetic analysis. Thirty-six fungal ITS sequences were retrieved from GenBank to determine the phylogenetic placement of *Hymenoscyphus* specimens (Table 1). *H. fructigenus* was chosen as the outgroup (Gross, Han, 2015). Sequence alignments were constructed in MEGA X (Kumar et al., 2018) using MUSCLE algorithm (Edgar, 2004) and trimmed manually. Phylogenetic analysis was conducted using Bayesian Inference (BI) and Maximum Likelihood (ML). ML were performed with RAXML GUI v. 2.0.14. The nodal support for the individual branches was estimated by bootstrapping using 1000 replicates. Bayesian analyses were conducted with BEAST v. 2.7.6 using Yule tree prior and strict molecular clocks (Bouckaert et al., 2014). A single chain of 10^7 steps was run with a burn-in of 25%.

RESULTS

An annotated species list

Ascomycota

Dothideomycetes

Botryosphaeriales

Botryosphaeriaceae

**Diplodia lonicerae* Fuckel – Ekb, MCP, on *Lonicera tatarica* L., coll. N. Azalova, det. A. Budimirov, T. Bulgakov, 09.07.2020, SVER(F) 17325.

Dothiorella sarmentorum (Fr.) A.J.L. Phillips, A. Alves et J. Luque (= *Diplodia melaena* Lév.; = *D. pruni* Fuckel) – Kamensk area, artificial treeline along the road "Kamensk-Uralsk-Ekaterinburg", on *Ulmus pumila* L., coll. N. Ushakova, det. A. Budimirov, T. Bulgakov, 21.09.1999, SVER(F) 17363; Ekb, suburb cottage village Palnix, on *Prunus armeniaca* L., coll. V. Zavorukhin, det. A. Budimirov, 25.05.2023, SVER(F) 17338. There are two new records in the region. The species was mentioned once before (Shiryaev et al., 2024).

Mycosphaerellales

Mycosphaerellaceae

Neophloeospora maculans (Bérenger) Videira et Crous [= *Mycosphaerella mori* (Fuckel) F.A. Wolf; = *Septoria mori* Fuckel] – Ekb, suburb cottage village Aleksandriya, on leaves of *Morus alba* L., coll. N. Azalova, det. A. Budimirov, T. Bulgakov, 26.09.2021, SVER(F) 17364. This is the second record in the region, the species has been mentioned earlier (Shiryaev et al., 2023c).

**Ruptoseptoria unedonis* (Roberge ex Desm.) Quaedvl., Verkley et Crous (≡ *Septoria unedonis* Roberge ex Desm.) – Ekb, greenhouse at the M.A. Nurov estate, on leaves of *Arbutus andrachne* L., coll. A. Kazanskiy, Z. Demidova, det. A. Budimirov, T. Bulgakov, 19.07.1928, SVER(F) 17337.

**Septoria aesculina* Thüm. – Ekb, BG UrB RAS, on leaves of *Aesculus hippocastanum* L., coll. N. Azalova, det. A. Budimirov, T. Bulgakov, 30.09.2020, SVER(F) 17339.

S. elaeagni (Chevall.) Desm. (≡ *Depazea elaeagni* Chevall.) – Beloyarsk area, artificial treeline along the road, on leaves of *Elaegnus angustifolia* L., coll. A. Sirko, det. A. Budimirov, T. Bulgakov, 04.10.1962, SVER(F) 17361. This is the second record in the region, the species has been mentioned earlier (Shiryaev, 2024).

Table 1. Voucher information and GenBank accession numbers for ITS sequences used in this study

Таблица 1. Информация о ваучерных образцах и регистрационных номерах GenBank для последовательностей ITS, использованных в данном исследовании

Species (current name)	Specimen/Isolate name	ITS	Location	Sequence origin
Hymenoscyphus fraxineus (T. Kowalski) Baral, Queloz et Hosoya	SVER(F) 17334	PX251630	Russia, the Middle Urals	this study
H. fraxineus	8096	KF188724	China	Drenkhan et al. (2017)
" "	EST3146-2	KR733591	Russia, Far East	" "
" "	EST3144	KP403806	Russia, Far East	" "
" "	EST2723	KR733600	Russia, Far East	" "
" "	EST3145	KP403807	Russia, Far East	" "
" "	EST3146	KR733592	Russia, Far East	" "
" "	080517.2	FJ429378	Lithuania	Ioos et al. (2009)
" "	08-410	FJ429376	France	" "
" "	080520	FJ429379	Lithuania	" "
" "	1582	FJ429380	Poland	" "
" "	CBS 122504	FJ597975	Poland	Kowalski, Holdenrieder (2009)
" "	KUS-F52255_1	KP068053	South Korea	Schoebel et al. (2014)
" "	PRM:857180	HF937557	Slovakia	Koukol et al. (2016)
" "	KUS-F52613	KF830853	South Korea	Han et al. (2014)
" "	TNS:F-40043	AB926104	Japan	unpublished
H. albidus (Gillet) W. Phillips	CBS 126533	MH864151	Switzerland	Böhm et al. (2024)
" "	EST2591	KP403803	Lithuania	" "
" "	CNRHalbLDPRO	MW238522	Italy	" "
" "	LOU-M-8	KC481686	France	" "
H. linearis Hosoya, Andr. Gross et Baral	Chic_01	KM114521	Japan	Gross et al. (2015)
" "	Chic_03	KM114523	Japan	" "
H. koreanus Andr. Gross et J.G. Han	KUS F52847_01	KP068057	South Korea	" "
" "	KUS-F52742_2	KP068074	South Korea	" "
" "	KUS-F52542_2	KP068078	South Korea	" "
H. albidoides H.D. Zheng et W.Y. Zhuang	HMAS 264141	KF188721	China	Zheng, Zhuang (2014)
" "	HMAS 264140	KF188722	China	" "
" "	HMAS 264142	KF188723	China	" "
H. pusillus T. Kowalski et Bilański	HMC 21525	MH476516	Poland	Kowalski, Bilański (2019)
" "	HMC 21521	MH476512	Poland	" "
" "	HMC 21523	MH476514	Poland	" "
" "	HMC 21527	MH476518	Poland	" "
H. occultus Andr. Gross et J.G. Han	KUS-F52847	KP068058	South Korea	Gross, Han (2015)
" "	KUS-F52847_22	KP068062	South Korea	" "
" "	KUS-F52847_24	KP068063	South Korea	" "
" "	KUS-F52847_25	KP068064	South Korea	" "
H. fructigenus (Bull.) Gray	CBS 650.92	GU586933	Germany	" "

**S. oleandrina* Sacc. – Ekb, greenhouse at the M.A. Nurov estate, on leaves of *Nerium oleander* L., coll. A. Kazanskiy, Z. Demidova, det. T. Bulgakov, A. Budimirov, 10.06.1928, SVER(F) 17365.

**S. robiniae* (Lib.) Desm. [≡ *Phloeospora robiniae* (Lib.) Höhn.] – Ekb, VG, on leaves of *Robinia pseudoacacia* L., coll. A. Shiryaev, det. T. Bulgakov, A. Budimirov, 18.09.2023, SVER(F) 17362.

Sphaerulina neoaceris Crous et Bulgakov – Ekb, Elizavet's church, on *Acer negundo*, coll. O. Clerc, det. A. Budimirov, T. Bulgakov, 01.09.1916, SVER(F) 17360. This is the earliest record of the species in the region. A later record has been already published in a previous paper (Bulgakov, Shiryaev, 2021).

**S. menispermi* (Thüm.) Quaedvl., Verkley et Crous (≡ *Septoria menispermi* Thüm.) – Ekb, VG, on leaves of *Menispermum dahuricum* DC., coll. N. Stepanova, det. A. Budimirov, T. Bulgakov, 24.08.1980, SVER(F) 17336.

Wilsonomyces carpophilus (Lév.) Adask., J.M. Ogawa et E.E. Butler [≡ *Stigmina carpophila* (Lév.) M.B. Ellis; ≡ *Thyrostroma carpophilum* (Lév.) B. Sutton] – Ekb, greenhouse of the Turbomotor Plant, on leaves of *Prunus laurocerasus*, coll. S. Kadochnikov, det. A. Budimirov, T. Bulgakov, 06.06.1994, SVER(F) 17340; *ibid.*, suburb cottage village Palnix, on *Prunus armeniaca* L., coll. N. Azalova, det. A. Budimirov, T. Bulgakov, 25.05.2023, SVER(F) 17359. The species was previously known in the region from two records (Bulgakov, Shiryaev, 2021).

Thyridariaceae

Thyridaria macrostomoides (De Not.) M.E. Barr [≡ *Lophiostoma macrostomoides* (De Not.) De Not.] – Ekb, MCP, on *Populus balsamifera* L., coll. A. Shiryaev, det. A. Budimirov, T. Bulgakov, 02.08.2021, SVER(F) 17358. The species was previously recorded on aspens and black poplars within the natural habitats of the region (Stepanova, Sirko, 1970).

Homortomycetales

Homortomycetaceae

!**Homortomyces* cf. *tamaricis* Wijayaw., Camporesi et K.D. Hyde – Ekb, BG UrB RAS, on *Tamarix ramosissima* Ledeb., coll. A. Shiryaev, det. T. Bulgakov, A. Budimirov, 30.05.2021, SVER(F) 17326.

Pleosporales

Camarosporidiellaceae

Camarosporidiella neomori Jaklitsch et Voglmayr [= *C. moricola* (Chethana, Bulgakov et K.D. Hyde) Wanas. et K.D. Hyde] – Ekb, suburb cottage village Palnix, on *Morus alba*, coll. N. Azalova, det. T. Bulgakov, 14.09.2023, SVER(F) 17335. This is the second record in the region, the species has been mentioned earlier (Shiryaev, 2024).

Didymellaceae

Neodidymelliopsis negundinis Manawas., Camporesi et K.D. Hyde – Krasnoufimsk town, terrace along the Ufa river, on *Acer negundo* L., coll. A. Shiryaev, det. T. Bulgakov, 03.09.2020, SVER(F) 17341. This is the third record in the region. The species was previously known from two records (Bulgakov, Shiryaev, 2022).

Leptosphaeriaceae

Longiseptatispora curvata Crous et Bulgakov [= *Rhabdospora lonicerae* (Cooke et Ellis) Sacc.] – Krasnoufimsk area, surrounds of Natalyinsk village, artificial treeline along the road, on dying twigs of *Lonicera tatarica* L., coll. A. Shiryaev, det. T. Bulgakov, 02.09.2023, SVER(F) 17357. This is the third record in the region. The species was previously known from two records (Shiryaev et al., 2023c).

Leotiomycetes

Helotiales

Erysiphaceae

**Arthrocladiella mougeotii* (Lév.) Vassilkov – Ekb, glasshouse of the Turbomotor Plant, on leaves of *Lycium barbarum* L., coll. S. Ljashko, det. A. Budimirov, 09.06.1993, SVER(F) 17342.

**Podosphaera leucotricha* (Ellis et Everh.) E.S. Salmon – Ekb, greenhouse at the M.A. Nurov estate, on leaves of *Pyrus malus* L., coll. O. Clerc, det. A. Budimirov, 26.05.1914, SVER(F) 17327.

Helotiaceae

Hymenoscyphus fraxineus (T. Kowalski) Baral, Queloz et Hosoya – Kamenskiy area, artificial treeline along the road, on fallen petioles of *Fraxinus excelsior* L., coll. V. Domrachev, det. T. Surina et L. Zaitseva, 02.08.2024, SVER(F) 17334. This is the third record in the region, the species has been mentioned earlier for Ekaterinburg city (Shiryaev, Kiseleva, 2023).

Note. *H. fraxineus* group now consists of seven species (Kowalski, Bilański, 2019). They are morphologically similar but clearly separated in phylogeny. Identification of specimen was confirmed using molecular methods. The specimen was grouped with other *H. fraxineus* strains with strong nodal support (Fig. 1).

Drepanopezizaceae

**Thedgonia ligustrina* (Boerema) B. Sutton – Ekb, suburb cottage village Karasyeozerskiy-2, on *Ligustrum vulgare* L., coll. S. Lyashko, det. T. Bulgakov, A. Budimirov, 21.09.2002, SVER(F) 17333.

Ploettnerulaceae

!**Pyrenopeziza lonicerae* Nannf. – Ekb, BG UFU, on *Lonicera chrysantha* Turcz. ex Ledeb., coll. P. Martushev, det. T. Bulgakov, A. Budimirov, 09.09.2024, SVER(F) 17356.

Incertae sedis

**Monostichella robergei* (Desm.) Höhn. – Ekb, suburb cottage village Karasyeozerskiy-2, on *Carpinus betulus* L., coll. V. Zavorukhin, det. T. Bulgakov, A. Budimirov, 22.09.2024, SVER(F) 17343.

Rhytismatales

Rhytismataceae

!**Lophomerum rhododendri* (Ces. ex Rehm) Remler – Ekb, BG UrB RAS, on *Rhododendron caucasicum* L., coll. A. Shiryaev, det. T. Bulgakov, A. Budimirov, 27.09.2022, SVER(F) 17355.

Sordariomycetes

Diaporthales

Gnomoniaceae

**Apiognomonia hystrix* (Tode) Sogonov [= *Gnomonia cerastis* (Riess) Ces. et De Not.] – Ekb, BCD, on dead fallen leaves of *Acer negundo* L., coll. A. Shiryaev, det. T. Bulgakov, 16.05.2025, SVER(F) 17332.

Melanconidaceae

**Melanconium populinum* Peck – Krasnoufimsk area, artificial treeline along the road, on *Populus balsamifera*, coll. A. Shiryaev, det. T. Bulgakov, 05.09.2023, SVER(F) 17354; Ekb, BCD, on *P. balsamifera*, coll. et det. T. Bulgakov, 13.09.2024, SVER(F) 17344; *ibid.*, Southwestern forest city park, on *P. balsamifera*, coll. et det. T. Bulgakov, 27.07.2022, SVER(F) 17366.

Xylariales

Graphostromataceae

**Biscogniauxia* cf. *dennisii* (Pouzar) Pouzar – Ekb, DP, on branches of *Quercus mongolica* Fisch. ex Ledeb., coll. N. Azalova, det. A. Budimirov, T. Bulgakov, 26.06.2021, SVER(F) 17353.

**B. mediterranea* (De Not.) Kuntze – Ekb, DP, on branch of *Juglans regia* L., coll. B. Panov, det. T. Bulgakov, A. Budimirov, 17.09.2000, SVER(F) 17345.

**B. mandshurica* Lar.N. Vassiljeva – Ekb, BG UrB RAS, on branch of *Malus mandshurica* (Maxim.) Kom., coll. N. Azalova, det. A. Budimirov, T. Bulgakov, 02.10.2022, SVER(F) 17331.

Hypoxylaceae

**Daldinia childiae* J.D. Rogers et Y.M. Ju – Ekb, MCP, on branch of *Fraxinus pensylvanica* Marshall, coll. A. Shiryaev, det. A. Budimirov, T. Bulgakov, 17.09.2023, SVER(F) 17352.

Xylariaceae

**Entoleuca mammata* (Wahlenb.) J.D. Rogers et Y.M. Ju – Ekb, Shartash forest park, on branches of *Populus suaveolens* Fisch., coll. V. Zavorukhin, det. T. Bulgakov, A. Budimirov, 03.08.2021, SVER(F) 17346.

Incertae sedis

!**Cheirospora botryospora* (Mont.) Berk. et Broome [= *Thyrsidium hedericola* (De Not.) Durieu et Mont.] – Ekb, greenhouse at the I.I. Simanov estate, on *Hedera helix* L., coll. O. Clerc, det. N. Naumov, 29.05.1897, SVER(F) 17328.

Basidiomycota

Agaricomycetes

Agaricales

Mycenaceae

**Mycena pseudocorticola* Kühner – Ekb, BG UrB RAS, on bark of *Quercus robur* L., coll. A. Shiryaev, det. O. Shiryaeva, 03.09.2023, SVER 910264.

Pleurotaceae

**Hohenbuehelia cyphelliformis* (Berk.) O.K. Mill. – Ekb, BG UrB RAS, on decayed stump of *Parthenocissus quinquefolia* (L.) Planch., coll. A. Shiryaev, det. O. Shiryaeva, 18.07.2015, SVER 910267.

Resupinataceae

**Resupinatus trichotis* (Pers.) Singer – Ekb, BG UrB RAS, on decayed stump of *Amelanchier* sp., coll. A. Shiryaev, det. O. Shiryaeva, 10.09.2023, SVER 910265.

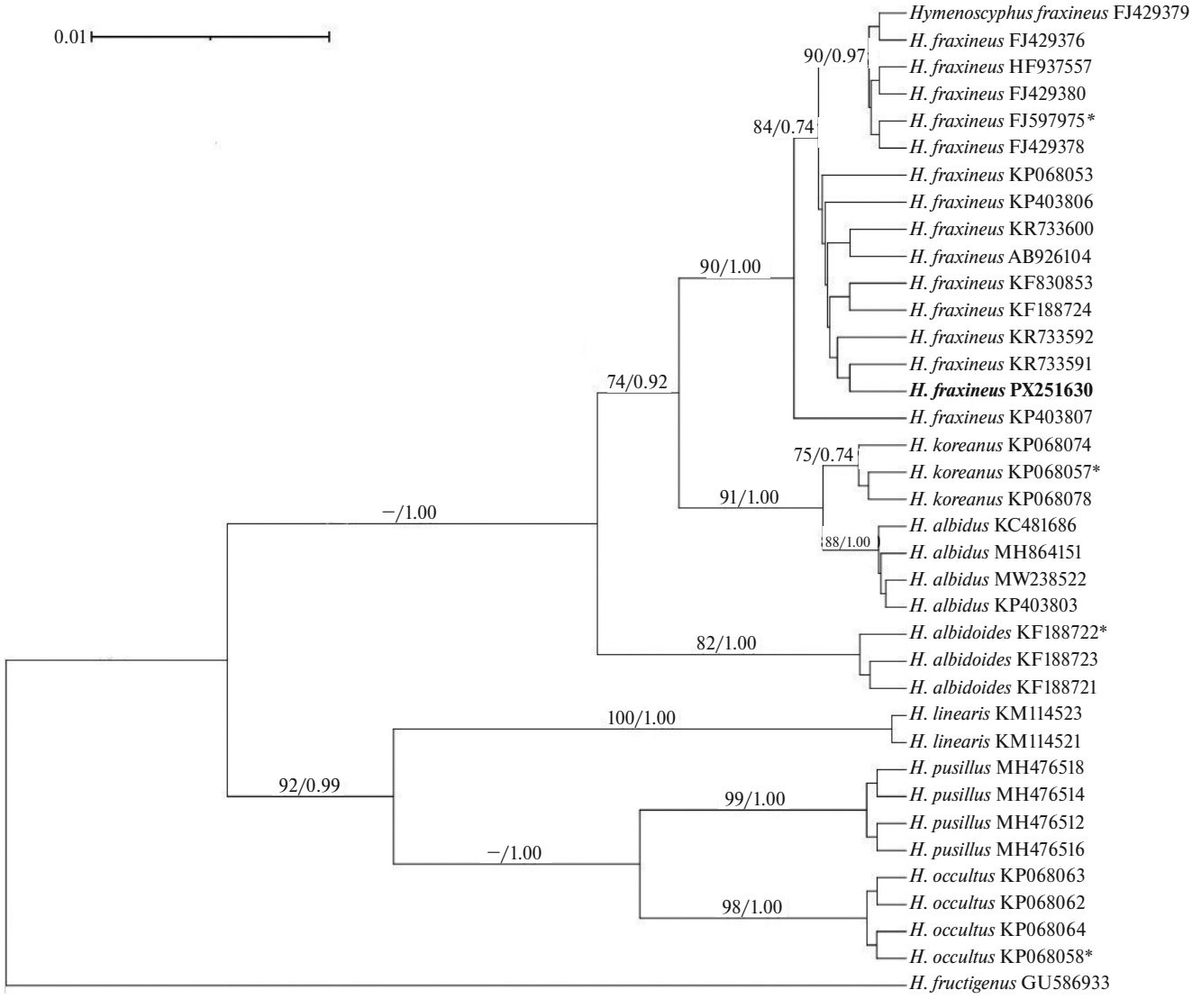

Fig. 1. Phylogram obtained from Bayesian analyses of ITS rDNA data for selected species in the *Hymenoscyphus fraxineus* group. Bootstrap percentages of Maximum Likelihood (with values ≥70%) are given above the branches in the left, while posterior probabilities of Bayesian analysis are given above the branches in the right. Sequence obtained during this study is presented in bold type. The asterisk indicates the type strains.

Рис. 1. Филограмма, полученная в результате байесовского анализа данных ITS рДНК для группы *Hymenoscyphus fraxineus*. Бутстреп-поддержка (ML) со значениями ≥70% приведена над ветвями слева, апостериорная вероятность (BI) – над ветвями справа Последовательность, полученная в ходе данного исследования, выделена жирным шрифтом. Звездочкой обозначены типовые штаммы.

Polyporales

Fomitopsidaceae

Antrodia kuzjana (Pilát) Spirin et Vlasák [= *Brunneoporus malicola* (Berk. et M.A. Curtis) Audet] – Ekb, BG UrB RAS, on the trunk of *Malus baccata* L., coll. et det. A. Shiryaev, 09.09.2024, SVER(F) 17351. This is the fourth record in the region; the previous records were published earlier (Shiryaev et al., 2010).

**Cyanosporus luteocaesius* (A. David) B.K. Cui, L.L. Shen et Y.C. Dai – Ekb, BG UrB RAS, on dead branch of *Pinus mugo* Turra, coll. A. Shiryaev, det. I. Zmitrovich, 02.10.2023, SVER(F) 17347.

Phanerochaetaceae

**Hyphodermella rosae* (Bres.) Nakasone – Ekb, greenhouse at the Rastorguev-Kharitonov estate, on the roots and the base of *Buxus colchica* Pojark., coll. I. Tikhonova, det. A. Shiryaev, 02.07.1990, SVER(F) 17350.

Polyporaceae

**Ganoderma valesiacum* Boud. – Ekb, BG UrB RAS, on the base of alive *Larix kurilensis* Mayr, coll. et det. A. Shiryaev, 03.06.2020, SVER(F) 17348.

Neofavolus suavissimus (Fr.) Seelan, Justo et Hibbett – Ekb, Obroshenskoe Forestry, on decayed stump of *Quercus robur* L., coll. A. Shiryaev, det. O. Shiryaeva, 23.07.2023, SVER 910266. This is the second record in the region, but the decaying wood of *Quercus* is an unusual substrate for this species. *Neofavolus suavissimus* typically decomposes wood of aspens, poplars, and willows. The species has previously been recorded on aspens within the natural habitats of the region (Mukhin et al., 2003).

Steccherinaceae

**Flaviporus brownii* (Humb.) Donk – Ekb, greenhouse at the M.A. Nurov estate, "on the wall of a tub with a palm from Batumi", coll. P. Syuzev, det. N. Naumov, 06.07.1894, SVER(F) 17329.

Loweomyces wynneae (Berk. et Broome) Jülich – Ekb, at the base of broken trunk of *Juglans mandshurica* Maxim., coll. A. Shiryaev, det. I. Zmitrovich, 17.09.2023, SVER(F) 17349. This is the third record in the region; the species has been mentioned earlier (Shiryaev et al., 2010).

Pucciniomycetes

Pucciniales

Pucciniaceae

Puccinia mirabilissima Peck – Ekb, D8, on leaves of *Mahonia aquifolium* (Pursh) Nutt. (= *Berberis aquifolium* Pursh), 03.09.2018, coll. N. Azalova, det. T. Bulgakov, SVER(F) 17330. This is third record in the region, the species has been mentioned earlier (Shiryaev et al., 2023).

DISCUSSION

A total of 42 species of phytopathogenic and saprobic fungi, belonging to the *Ascomycota* and *Basidiomycota* divisions, were identified growing on alien trees and shrubs. Among these, 28 species are newly recorded in Sverdlovsk Region, while 14 are considered rare, with only two to four documented occurrences in the area. Additionally, four species – *Cheirospora botryospora*, *Homortomyces tamaricis*, *Lophomerum rhododendri*, and *Pyrenopeziza lonicerae* – are being reported in Russia for the first time.

Fungi were found on 34 species of alien woody plants, including 27 species growing in open ground (*Acer negundo*, *Aesculus hippocastanum*, *Carpinus betulus*, *Elaegnus angustifolia, Fraxinus excelsior, F. pennsylvanica*, *Juglans mandshurica*, *J. regia*, *Larix kurilensis*, *Ligustrum vulgare*, *Lonicera chrysantha*, *L. tatarica*, *Mahonia aquifolium*, *Malus baccata*, *M. mandshurica*, *Menispermum dahuricum*, *Morus alba*, *Pinus mugo*, *Populus balsamifera*, *Populus suaveolens*, *Prunus armeniaca*, *Quercus mongolica*, *Q. robur*, *Rhododendron caucasicum*, *Robinia pseudoacacia*, *Tamarix ramosissima*, *Ulmus pumila*), as well as seven species growing in greenhouses (*Arbutus andrachne*, *Buxus colchica*, *Hedera helix*, *Lycium barbarum*, *Nerium oleander*, *Prunus laurocerasus*, *Pyrus malus*). Fungi were collected from different parts of the trees and shrubs, such as leaves, twigs, bark, and wood.

Three fungal species (*Hymenoscyphus fraxineus*, *Entoleuca mammata*, and *Biscogniauxia mediterranea*) are the dangerous invasive pathogens of woody plants (Beenken, Senn-Irlet, 2016; Rabitsch, Nehring, 2021; Voglmayr et al., 2023).

Hymenoscyphus fraxineus is known as an invasive species causing the ash dieback disease (*Fraxinus* spp.), also known as Chalara ash dieback, which was named after *Chalara fraxinea* T. Kovalski – the widely used name of the anamorphic stage of *Hymenoscyphus fraxineus* (Pacia et al., 2023; Zvyagintsev et al., 2023). This harmful phytopathogenic fungus was proposed to be accidentally introduced from East Asia (where it affects native *Fraxinus mandshurica* Rupr.) to Europe in the early 21st century (Zhao et al., 2013) and quickly spread throughout the range of *F. excelsior* and other ash species in most European countries, causing massive dying of ash trees in natural and artificial forests (Pacia et al., 2023). During the 2000s and 2010s, *Hymenoscyphus fraxineus* expanded its range eastward and reached Moscow Region in 2014 (Musolin et al., 2017). After the long-term fixed-route survey, ash dieback disease caused by *H. fraxineus* was found on the territory of 31 regions in Russia now (Zvyagintsev et al., 2023). Thus, ash dieback now appeared to be a widespread pathology of *Fraxinus* species in their range in most regions of European Russia, including the North Caucasus and Middle Volga. Recent studies suggest that *H. fraxineus* may not be a virulent shoot pathogen on Asian ash species in their native range; moreover, that the current ash dieback epidemic in Europe may not originate directly from the East Asia, or European strains of *H. fraxineus* represent rare genetic variants that have not yet been detected in East Asia (Drenkhan et al., 2017).

The ITS1–5.8S–ITS2 sequence obtained from material collected during the present study differs from the holotype strain of *H. fraxineus* originating from Poland (FJ597975) and from the other European materials by an insertion at position 83 (G instead of a gap) and a point mutation at position 124 (C instead of T) within the ITS1 region. All sequences of *H. fraxineus* originating from the Russian Far East, China, Korea, and Japan were conserved at these two sites (Drenkhan et al., 2017). So, the local *H. fraxineus* strain has conspicuous differences in ITS rDNA sequences from European populations of this species and shows the standard East Asian sequence variant. This suggests that local populations of *H. fraxineus* in Sverdlovsk Region may not originate from Europe but rather from East Asia. Further research is needed to investigate the genetic diversity populations of *H. fraxineus* associated with ash species in the Urals and the virulence of the species.

Entoleuca mammata [= *Hypoxylon pruinatum* (Klotzsch) Cooke] is a well-known invasive fungal plant pathogen, accidentally introduced from North America to Europe until the 20th century (probably in the 18th century) (Kasanen et al., 2004). This fungus causes the poplar disease known as Hypoxylon cancer, affecting mainly species of the genus *Populus* section *Populus*, most often aspens (Ostry, 2013). This pathogen of poplars is widespread now in most European countries but is especially common in Northern and Western Europe, where it forms a specific fungus-plant pathosystem (Ostry, Anderson, 2009). In Russia, *Entoleuca mammata* affects common aspen (*Populus tremula* L.) and white poplar (*P. alba* L.), causing slow dying of middle-aged and older trees in natural forests throughout the range of aspen and white poplar in European Russia (Bulgakov et al., 2014), the Urals, and Siberia (Kuzmichev et al., 2001). So, the records of this species in Sverdlovsk Region are quite expected.

Biscogniauxia mediterranea is a widespread endophytic fungus that causes cancer and wood rot (Charcoal disease) of many woody plants (Ranjana, Basu, 2012). This species is most common in subtropical Mediterranean countries from Portugal to Iran (Ju et al., 1998; Costa et al., 2022; Kazemzadeh et al., 2021), but is also recorded in East Asia (Ju et al., 1998), South Africa (van der Merwe et al., 2021), and North America (Spaulding, 1961). According to numerous studies,

B. mediterranea can affect many woody plants (Ju et al., 1998; Ragazzi et al., 2012; Ranjana, Basu, 2012), but most often it infects Fagales species (*Fagus*, *Quercus*, *Juglans* and other tree species). The records of this species on walnut (*Juglans regia*) in Sverdlovsk Region can be considered a result of accidental introduction, as well as global warming and aridization of the regional climate, which favor to the invading of subtropical fungal species into the boreonemoral lands of the Urals and further naturalization of alien fungi.

Thus, the present paper supplements information on the phytopathogenic and saprobic fungi (*Ascomycota*, *Basidiomycota*) growing on alien trees and shrubs, including dangerous invasive species.

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Новые и редкие виды грибов, развивающиеся на интродуцированных древесно-кустарниковых растениях в Свердловской области (Средний Урал, Россия)

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Впервые для Свердловской обл. приводятся сведения о находках 28 видов фитопатогенных и сапротрофных высших грибов (*Ascomycota* и *Basidiomycota*), найденных на интродуцированных видах деревьев и кустарников. Образцы еще 14 редких видов собраны в регионе во второй – четвертый раз. Четыре вида – *Cheirospora botryospora*, *Homortomyces tamaricis*, *Lophomerum rhododendri* и *Pyrenopeziza lonicerae* – обнаружены в России впервые. Грибы собраны на 34 видах древесных и кустарниковых растений, включая 27 видов, развивающихся в открытом грунте, и семь в оранжереях. Приводятся сведения о местонахождениях опасных фитопатогенных грибов: *Biscogniauxia mediterranea*, *Entoleuca mammata*, а также *Hymenoscyphus fraxineus*, для которого выявлено новое местонахождение. Анализ последовательности ITS1–5.8S–ITS2, полученной из собранных в ходе текущего исследования апотециев *H. fraxineus*, показал заметные отличия от европейских популяций этого вида и продемонстрировал сходство с восточноазиатским вариантом последовательности. Таким образом, вновь найденные местные варианты *H. fraxineus* в Свердловской обл. могут иметь не европейское, а восточноазиатское происхождение.

Ключевые слова: биоразнообразие, инвазия, патогены растений, распространение грибов, чужеродные виды, *Ascomycota*, *Basidiomycota*