

New, rare, and interesting lichenological records in Moscow and Moscow Region (European Russia)

E. E. Muchnik¹, D. A. Cherepenina^{1,2,3}, A. G. Tsurukau^{4,5,6},
E. Yu. Blagoveschenskaya⁷, E. P. Gudkova⁷

¹Institute of Forest Science of the Russian Academy of Sciences, Moscow Region, Russia

²Tsitsin Main Botanical Garden of the Russian Academy of Sciences, Moscow, Russia

³Peoples' Friendship University of Russia (RUDN), Moscow, Russia

⁴Francisk Skorina Gomel State University, Gomel, Republic of Belarus

⁵Gomel State Medical University, Gomel, Republic of Belarus

⁶Samara National Research University, Samara, Russia

⁷Lomonosov Moscow State University, Russia

Corresponding author: E. E. Muchnik, emuchnik@outlook.com

Abstract. This paper provides data on 26 new, rare, and interesting species of lichens discovered in the city of Moscow and Moscow Region during the field studies in 2014–2022, of which 21 species are new to the study area. *Fellhaneropsis vezdae* is new to the European part of Russia, and *Briancoppinsia cytospora*, *Thelidium minimum*, and *Verrucaria inaspecta* are new to the Central Russia. The list of lichens and allied fungi of the city of Moscow and Moscow Region currently includes 493 species.

Keywords: *Fellhaneropsis vezdae*, lichens, allied fungi, the city of Moscow, Moscow Region.

Новые, редкие и интересные лихенологические находки в Московском регионе (Европейская Россия)

Е. Э. Мучник¹, Д. А. Черепенина^{1,2,3}, А. Г. Цуриков^{4,5,6},
Е. Ю. Благовещенская⁷, Е. П. Гудкова⁷

¹Институт лесоведения РАН, Московская обл., Россия

²Главный ботанический сад им. Н. В. Цицина РАН, Москва, Россия

³Российский университет дружбы народов (РУДН), Москва, Россия

⁴Гомельский государственный университет им. Франциска Скорины, Гомель,
Республика Беларусь

⁵Гомельский государственный медицинский университет, Гомель, Республика Беларусь

⁶Самарский национальный исследовательский университет им. академика С. П. Королева,
Самара, Россия

⁷Московский государственный университет им. М. В. Ломоносова, Москва, Россия

Автор для переписки: Е. Э. Мучник, emuchnik@outlook.com

Резюме. По материалам, собранным в Московском регионе в период с 2014 по 2022 г., приводятся 26 видов, 21 из которых является новым для Московского региона. *Fellhaneropsis vezdae* впервые указан для европейской части России, *Briancoppinsia cytospora*, *Thelidium minimum*

и *Verrucaria inaspecta* — для Центральной России. Список лишайников и родственных им грибов Москвы и Московской обл. составляет в настоящее время 493 вида.

Ключевые слова: *Fellhaneropsis vezdae*, лишайники и родственные им грибы, Москва, Московская область.

The city of Moscow (2.6 thousand km²) and Moscow Region (44.3 thousand km²) are different constituent entities of the Russian Federation. They are situated in the central part of the East European (Russian) Plain. The relief is mostly flat, with alternating hills and lowlands (Kolosova, Churilova, 2004). The climate is temperate continental with distinct seasonal changes, winters are moderately cold, and summers are warm and humid. The average monthly temperature for the hottest month (July) varies from +18.5 to +19.7 °C, and for the coldest month (January) — from –7.8 to –6.2 °C. There is approximately 590 to 712 mm of precipitation per year (Hydrometeorological..., 2023). Most of the territory (to the north from the Oka River) is in the subzone of coniferous-deciduous forests, the southern part is in the subzone of broadleaved forests, and the extreme south is in the forest-steppe zone (Petrov, 1968; Suslova, 2019).

Data on the lichen biota of the region have been accumulated for more than two centuries, starting from the first edition of the work by F. Stephan (1792, cited from: Elenkin, 1906–1911). At the beginning of the 20th century A. A. Elenkin summarized the data from his own research, collections of various authors, as well as data presented in the publications of various scientists (F. Stephan, H. Martius, A. Müller, D. Goldbach, N. Annenkoff, K. Heyden, N. A. Mosolov, V. S. Dokturovsky, I. P. Petrov, etc.). As a result, Elenkin listed 202 species of lichens (in the modern understanding of taxa) for the territory of the city of Moscow and Moscow Region (Elenkin, 1906–1911). In the 1960s, the revised list included 267 species (Golubkova, 1962). Subsequently, the study of lichens of the city of Moscow and Moscow Region was continued by L. G. Biazrov, A. V. Pchelkin, T. Yu. Tolpysheva, A. A. Notov and others (Biazrov, 1996, 2009, 2012, 2015; Pchelkin, 2005; Notov, 2010, 2019; Pchelkin, Pchelkina, 2012; Tolpysheva, 2020; *et al.*). Despite the lichen list has reached 472 species, the lichen flora of this territory definitely remains insufficiently known. In this work we provide new, rare, and interesting findings of lichens and allied saprotrophic or lichenicolous fungi for the city of Moscow and Moscow Region.

Material and Methods

The material was collected E. E. Muchnik, D. A. Cherepenina, E. P. Gudkova, and E. Yu. Blagoveshchenskaya in the period 2014–2022 on the territory of the city of Moscow and Moscow Region. The map of the collection points is located in Fig. 1.

Identification of samples was carried out using standard lichenological methods (Stepanchikova, Gagarina, 2014) mainly on the basis of the Institute of Forest Science RAS, and Francisk Skorina Gomel State University (Republic of Belarus). Studies of lichen secondary metabolites were performed using thin-layer chromatography (TLC) in solvent system C (Orange *et al.*, 2010). The correctness of several species

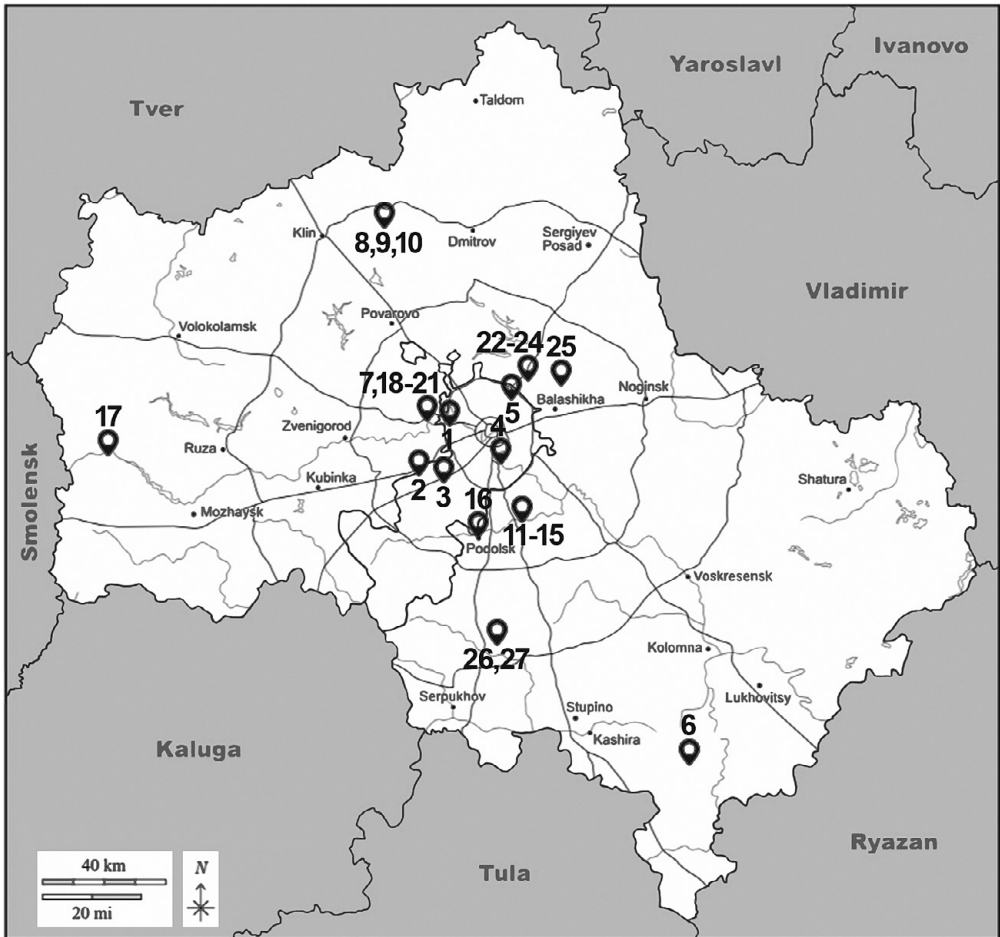


Fig. 1. The map of the collection points. Collection points located very close to each other for the scale of the map are marked by one icon with several digits.

identifications was checked in the laboratory of lichenology and bryology of the Komarov Botanical Institute of the Russian Academy of Sciences. Three specimens of *Verrucaria* were identified by O. Breuss (University of Vienna, Austria) and are stored in his personal herbarium. The remaining materials were identified mainly by E. E. Muchnik, D. A. Cherepenina, E. P. Gudkova, and A. G. Tsurykau. These samples are mainly located in the herbaria of the Tsitsin Main Botanical Garden RAS (MHA) and the Komarov Botanical Institute RAS (LE).

Images of thallus and anatomical structures of *Fellhaneropsis vezdae* were made using a Leica M80 microscope with a Leica IC80 HD camera, and a Leica DM500 with a Leica ICC50 HD camera, respectively. Leica LAS EZ software was used for photography. Photographs were stitched with the Helicon Focus software.

The nomenclature of the species of lichens and lichenicolous fungi corresponds to the modern checklist of lichens of Scandinavia (Westberg *et al.*, 2021). Nomenclature of saprobic non-lichenized fungi is given according to the Index Fungorum (2023).

Sampling locations

The city of Moscow: 1 – North-Western Administrative Okrug, State Natural Reserve “Forests of Serebryanoborsky forestry”, 5 quarter, 55°46'48.9", 37°22'33.1"E, old-growth pine forest with linden, 21 VI 2016, *Muchnik*; 2 – Novomoskovsky Administrative Okrug, vicinity of Postnikovo, Ulyanovsk Forest Park, 24 quarter, 55°36'33.1"N, 37°14'13.1"E, birch forest, 28 VI 2018, *Muchnik*; 3 – *ibid.*, Valuevsky Forest Park, 16 quarter, 55°34'26.8"N, 37°20'55.0"E, mixed coniferous-broadleaved forest, 15 V 2017, *Muchnik*; 4 – Southern Administrative Okrug, Museum-Reserve “Kolomenskoye-Izmailovo”, 55°39'23.6"N, 37°40'10.2"E, old park “Kolomenskoye”, 26 VII 2021, *Cherepenina*; 5 – Eastern Administrative Okrug, Losiny Ostrov National Park, Losinoostrovsky Forest Park, floodplain of the Los' River, 55°52'00.1"N, 37°43'53.5"E, temperate broadleaved forest, 4 X 2020, *Muchnik*. **Moscow Region:** 6 – Zaraysk Urban Okrug, vicinity of Bolshie Belynichi, 54°37'34.7"N, 38°49'23.2"E, bank of the Osyotr River, limestone outcrops along a steppe slope, 24 VIII 2014, *Muchnik*; 7 – Odintsovo Urban Okrug, State Natural Reserve “Forests of Serebryanoborsky forestry”, 3 quarter, 55°47'33.1"N, 37°22'10.5"E, temperate broadleaved forest, 5 VI 2015, *Muchnik*; 8 – Solnechnogorsk Urban Okrug, Tarakanovo, Museum-Reserve of D. I. Mendeleev and A. A. Blok (Tarakanovo estate), 56°20'01.9"N, 37°02'44.4"E, old park, 22 VIII 2020, *Cherepenina*; 9 – *ibid.*, 56°20'03.5"N, 37°02'43.8"E, old park, 22 VIII 2020, *Cherepenina*; 10 – *ibid.*, Gudino, Museum-Reserve of D. I. Mendeleev and A. A. Blok (Shakhmatovo estate), 56°18'51.0"N, 37°03'06.1"E, old park, 15 VIII 2020, *Cherepenina*; 11 – Leninsky Urban Okrug, Gorki Leninskie, Museum-Reserve “Gorki Leninskie”, 55°30'13.4"N, 37°45'40.4"E, old park, 18 X 2019, *Muchnik*, *Cherepenina*; 12 – *ibid.*, 55°30'38.4"N, 37°46'27.3"E, old park, 18 X 2019, *Muchnik*, *Cherepenina*; 13 – *ibid.*, 55°30'29"N, 37°46'11.1"E, old park, 20 VIII 2019, *Cherepenina*; 14 – *ibid.*, 55°30'18.5"N, 37°46'05.5"E, old park, 29 VI 2020, *Cherepenina*; 15 – *ibid.*, 55°30'11.6"N, 37°46'06.7"E, old park, 4 VII 2020, *Cherepenina*; 16 – Podolsk, Museum-Reserve “Podolie”, 55°26'20.0"N, 37°33'27.6"E, old park, 8 VIII 2020, *Cherepenina*; 17 – Mozhaysk Urban Okrug, State Natural Reserve “Coniferous forests in the upper reaches of the Moscow River”, south of Kholmichi, 55°40'39.1"N, 35°21'23.9"E, mixed coniferous-broadleaved forest, 12 IX 2021, *Muchnik*; 18 – Krasnogorsk Urban Okrug, Arkhangelskoye, Museum-Reserve “Arkhangelskoye”, 55°47'01.3"N, 37°17'16.1"E, old park, 2 X 2021, *Cherepenina*; 19 – *ibid.*, 55°47'11.5"N, 37°16'50.9"E, old park, 2 X 2021, *Cherepenina*; 20 – *ibid.*, 55°46'56.6"N, 37°17'01.9"E, old park, 3 X 2021, *Cherepenina*; 21 – *ibid.*, 55°47'11.2"N, 37°17'22.9"E, old park, 3 X 2021, *Cherepenina*; 22 – Mytishchi Urban Okrug, Losiny Ostrov National Park, Mytishchi Forest Park, 24 quarter, 55°53'48.8"N 37°48'07.3"E, mixed coniferous-broadleaved forest, 13 VII 2022, *Muchnik*, *Gudkova*; 23 – *ibid.*, 26 quarter, 55°53'44.7"N, 37°49'05.8"E, mixed coniferous-broadleaved forest, 13 VII 2022, *Muchnik*, *Gudkova*; 24 – *ibid.*, 36 quarter, 55°54'01.9"N, 37°46'53.7"E, mixed coniferous-broadleaved forest, 13 VII 2022, *Muchnik*, *Gudkova*; 25 – Korolyov Urban Okrug, Losiny Ostrov National Park, Alekseevsky Forest Park, 2 quarter, 55°53'16.6"N, 37°55'18.7"E, mixed coniferous-broadleaved forest, 17 VIII 2022, *Gudkova*, *Blagoveshchenskaya*; 26 – Chekhov Urban Okrug, Melikhovo, Museum-Reserve of A. P. Chekhov “Melikhovo” (Melikhovo estate), 55°06'50.5"N, 37°38'51.2"E, old park, 22 VII 2022, *Cherepenina*; 27 – *ibid.*, 55°06'50.5"N, 37°38'50.6"E, old park, 27 VII 2022, *Cherepenina*.

Results and Discussion

An annotated list of species is presented in alphabetical order. The species reported for the first time for the Central Russia (i. e. Central Federal District) are marked with !; the species reported for the first time for the European part of Russia are marked with !!; lichenicolous fungi are marked with #; species of saprobic non-lichenized fungi

are marked with +. Locality, substrate, author of the identification, and herbarium number of the specimen are provided for each species, as well as brief comments on the species distribution. The identified secondary metabolites are given for the specimens analyzed by TLC. Comments on species new to Central Russia and the European part of Russia contain the main characteristics useful for identification.

Absoconditella delutula (Nyl.) Coppins et H. Kiliias – 17, on decaying wood, det. *S. V. Chesnokov*, MHA 9095500. A rather rarely reported species in the Central Russia previously recorded sporadically in the Tver (Notov, 2010), Vladimir (Zhdanov, Volosnova, 2012), and Belgorod (Konoreva, Muchnik, 2013) regions.

Arthonia didyma Körb. – 17, on bark of *Populus tremula* L., MHA 9095501. It was reported from many regions of the Central Russia, the closest location is in the Tver Region (Himelbrant *et al.*, 2011).

A. dispersa Nyl. – 23, on bark of *Corylus avellana* (L.) H. Karst., *Gudkova*, conf. *Muchnik*, LE L-25787; 26, on bark of fallen *Populus tremula* trunk, *Gudkova*, conf. *Muchnik*, herb. of *Gudkova*. In the Central Russia it was previously reported from the Belgorod and Kursk regions (Muchnik *et al.*, 2007).

Athallia cerinella (Nyl.) Arup *et al.* – 25, on bark of fallen *Populus tremula* trunk, *Gudkova*, conf. *Muchnik*, LE L-25788. This is the second finding in the Moscow Region. Previously the species was reported from the Porechye park in Mozhaisk Urban Okrug (Tolpysheva, 2020).

Bacidina arnoldiana (Körb.) V. Wirth et Vězda – 15, on artificial rocky substrate, det. *Yu. V. Gerasimova*, MHA 9095502; 27, on rocky substrate, det. *Muchnik*, MHA 9095503. In the Central Russia the species is known from several regions, the nearest location is in the Tver Region, Zavidovo National Park (Notov, 2019).

!#Briancoppinsia cytospora (Vouaux) Diederich *et al.* – 26, on thallus of *Parmelia sulcata* Taylor on bark of *Picea abies* (L.) H. Karst., det. *Tsurykau*, MHA 9095504. In the European part of Russia it is known in the Mordovia State Reserve, the Republic of Mordovia (Urbanavichene, Urbanavichus, 2015).

+Chaenothecopsis pusiola (Ach.) Vain. – 8, on bark of *Larix* sp., det. *Muchnik*, MHA 9095505. This is the second finding in the Moscow Region. Previously it was noted in Lotoshino Urban Okrug in the Zavidovo National Park (Notov, 2010).

Cladonia bacilliformis (Nyl.) Glück – 2, on bark at the base of *Betula* sp. with mosses, MHA 9095506. This is the first finding in the city of Moscow. Previously it was noted in the Moscow Region (Muchnik, 2016a).

Coenogonium pineti (Ach.) Lücking et Lumbsch – 1, on wood of pine stump, MHA 9095287; 3, on bark at the base of old *Picea abies* and *Quercus robur* L., MHA 9095288, 9095289; 18, on bark of *Pinus sylvestris* L., det. *Tsurykau*, MHA 9095507. A fairly common species in the Central Russia, the closest locations are in the Smolensk (Gagarina *et al.*, 2020) and Tver (Notov *et al.*, 2011) regions.

!!Fellhaneropsis vezdae (Coppins et P. James) Sérus. et Coppins (Fig. 2) – 7, on moss-covered bark at the base of *Tilia cordata* Mill., det. *Paukov*, LE L-25789. The specimen lacks secondary lichen metabolites. It is widespread in many countries of Western and Eastern Europe, North and South America. In Russia it was detected only in the Sverdlovsk Region, Nature Park “Olen’ji Ruchji” (Paukov, Teptina, 2012). The species is inconspicuous and may be overlooked. It is usually known in its sterile state with creamy to light brown, initially sessile, later elongated pycnidia containing thin and long (up to $50 \times 1 \mu\text{m}$) conidia (Coppins, James, 1978).

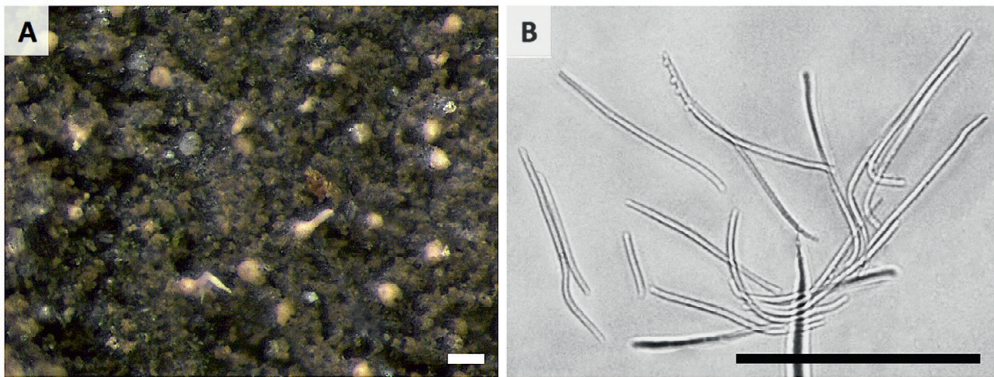


Fig. 2. *Fellhaneropsis vezdae* (LE L-25789): A – pycnidia, B – conidia. Scale bars: A – 0.1 mm, B – 50 μ m. Photo by Gudkova.

#*Illosporopsis christiansenii* (B. L. Brady et D. Hawksw.) D. Hawksw. – 10, on thallus of *Physcia adscendens* H. Olivier on bark of *Caragana arborescens* Lam., MHA 9095508; 13, on thallus of *Physcia tenella* (Scop.) DC. on bark of deciduous tree, det. *Tsurykau*, MHA 9095509; 20, on thallus of *Physcia* sp. on bark of fallen branch of *Tilia cordata*, det. *Tsurykau*, MHA 9095510, on thalli of *Phaeophyscia orbicularis* (Neck.) Moberg and *Physcia aipolia* (Ehrh. ex Humb.) Fűrnr. on bark of fallen branch of tree, det. *Tsurykau*, MHA 9095511. The species is common in the Central Russia, the closest locality is in Tver Region, the Central Forest Reserve (Notov *et al.*, 2014).

Lecanora stanislai Guzew-Krzeminska *et al.* – 21, on bark of *Tilia cordata*, det. *Tsurykau*, MHA 9095512. The sample contains zeorin and usnic acid. In the Central Russia this species was reported only from the Bryansk and Tula regions (Muchnik, 2020, 2023).

Melanohalea elegantula (Zahlbr.) O. Blanco *et al.* – 15, on bark of *Acer platanoides* L., det. *Muchnik*, MHA 9095513. Previously the species was reported from the city of Moscow and Moscow Region by Biazrov (2009, 2012), but those reports cited no exact locality.

Micarea soralifera Guzew-Krzem. *et al.* – 17, on decaying wood, det. *S. V. Chesnokov*, MHA 9095514. In the Central Russia the species is known from the Tula (Muchnik, 2021), Bryansk, Tver, and Ryazan (Muchnik *et al.*, 2022a, b) regions.

Myriolecis albescens (Hoffm.) Śliwa *et al.* – 6, on limestone, MHA 9095515; 11, on artificial rocky substrate (concrete), det. *Muchnik*, MHA 9095516. The species is known from several regions of the Central Russia, the nearest localities are in the Vladimir (Zhdanov, Volosnova, 2012) and Tver (Notov *et al.*, 2011) regions.

Naetrocymbe punctiformis (Pers.) R. C. Harris – 4, on bark of *Tilia cordata*, det. *Muchnik*, MHA 9095517; 5, on bark of *Betula* sp., MHA 9095518; 9, on bark of *Quercus robur*, det. *Muchnik*, MHA 9095519. The species is widespread in the Central Russia, the closest locality was noted in the Tver Region, Zavidovo National Park (Notov, 2010).

+*Rebentischia massalongii* (Mont.) Sacc. – 24, on bark of *Betula* sp., det. *S. V. Chesnokov*, LE L-25790. In the Central Russia it has been previously known only in the Kostroma Region (Urbanavichene, Urbanavichus, 2021).

+*Sarea resinae* (Fr.) Kuntze – 18, on resin-covered wood of *Picea abies*, det. *Muchnik*, MHA 9095520. The species is scattered in the Central Russia, the closest locality is in the Tver Region (Notov *et al.*, 2011).

Strangospora deplanata (Almq.) Clauzade et Cl. Roux – 22, on wood of fallen *Picea abies*, Gudkova, conf. Muchnik, LE L-25791. The species was previously reported from the territory of the city of Moscow by Biazrov (2015), but that report cited no exact locality.

Thelidium minimum (A. Massal. ex Körb.) Arnold – 26, on artificial rocky substrate (concrete), det. Muchnik, MHA 9095521. In the European part it is known from the Leningrad Region (Kopachevskaya, 1977; Pykälä *et al.*, 2012) and the Nenets Autonomous Area (Urbanavichus *et al.*, 2009).

T. minutulum Körb. – 8, on artificial rocky substrate, det. Muchnik, MHA 9095522. This species has scattered distribution in the Central Russia, the nearest locality is in the Tver Region (Notov *et al.*, 2011).

Verrucaria glaucovirens Grummann – 16, on artificial rocky substrate together with *V. ochrostoma* Borrer, det. O. Breuss, herb. Breuss 34406. This is the second record in the Central Russia. Previously the species was known only from the Lipetsk Region (Muchnik, 2012).

IV. inaspecta Servit – 13, on artificial rocky substrate, det. O. Breuss, herb. Breuss 35404. In the European part of Russia it has been previously known only from the Leningrad Region (Pykälä *et al.*, 2012).

V. ochrostoma Borrer – 16, on artificial rocky substrate, det. O. Breuss, herb. Breuss 34406. In the Central Russia it was previously reported from the Orel (Muchnik, 2016b) and the Lipetsk (Muchnik *et al.*, 2022b) regions.

V. rupestris Schrad. – 12 and 27, on artificial rocky substrate, det. Muchnik, MHA 9095523, 9095524. In the Central Russia it was previously reported from the Lipetsk and Tula regions (Muchnik, 2021).

Xanthomendoza ulophyllodes (Räsänen) Søchting *et al.* – 14, on bark of *Malus* sp., det. Muchnik, MHA 9095525. In the Central Russia the species was reported from the Voronezh (Tomin, 1926) and Tver (Himelbrant *et al.*, 2011) regions.

Altogether, 21 species are new for the city of Moscow and Moscow Region. Of these, three species are new for the Central Russia, one for the European part of Russia. Five species had single records from the Moscow study area with no exact data on their locality and ecology.

Sixteen species of lichens and related fungi were found in the old parks of museum-reserves. The others were collected within specially protected natural areas, the lichen biota of which has not yet been sufficiently studied. *Arthonia didyma*, *Chaenothecopsis pusiola*, *Fellhaneropsis vezdae*, *Micarea soralifera*, *Sarea resiniae*, *Thelidium minimum*, and *Xanthomendoza ulophyllodes* can be considered rare on the investigated territory. Of these, *Chaenothecopsis pusiola* is an indicator of old-growth intact forest communities in the North-West of the European part of Russia (Himelbrant, Kuznetsova, 2009), and it retains its indicator properties in the subzone of coniferous-deciduous forests of Central Russia (Muchnik, 2015). In the Central Russia, *Arthonia didyma*, *Micarea soralifera*, and *Sarea resiniae* are known mainly from old natural forests, not highly affected by urban influence (Muchnik, 2015, 2021; Guzow-Krzemińska *et al.*, 2016; Muchnik *et al.*, 2022a, b). Unfortunately, there are few such forests left in Moscow and Moscow Region. *Fellhaneropsis vezdae* is quite widespread in the oceanic and suboceanic zones of Europe and North America (Aptroot and Edwards, 2009), but it

is apparently more rare in the continental climate of the Central Russia. *Thelidium minimum* and *Xanthomendoza ulophyllodes* can probably be considered as species with scattered occurrence. In the European part of Russia, both species have sporadic distribution even though their characteristic substrates are very widespread. The remaining species from our list may not be so rare in the studied area and further careful examination of suitable communities and substrates may reveal their wider distribution.

The list of lichens and allied fungi of the city of Moscow and the Moscow Region currently includes 493 species, however, some are known only from the literary data. Further field studies and revision of old herbarium collections of herbaria of Lomonosov Moscow State University (MW) and Komarov Botanical Institute RAS (LE) are required to provide further changes in the lichen list of the Moscow Region.

Acknowledgments

Authors express their deep gratitude to O. Breuss (University of Vienna, Austria), S. V. Chesnokov (Komarov Botanical Institute RAS, St. Petersburg, Russia), and A. G. Paukov (Ural Federal University named after the first President of Russia B. N. Yeltsin, Yekaterinburg, Russia) for assistance in identification of some critical specimens. We thank the staff of the Laboratory of Lichenology and Bryology of the Komarov Botanical Institute RAS for the opportunity to work in the herbarium (LE). Two anonymous reviewers are warmly thanked for the constructive comments and suggestions on the manuscript. The work of E. E. Muchnik and D. A. Cherepenina was carried out within the framework of the theme of the state assignment of Institute of Forest Science RAS (no. 1021032421253-6-1.6.19), additionally the work of D. A. Cherepenina was carried out within the framework of the theme of the state assignment of Tsitsin Main Botanical Garden RAS (no. 122042700002-6). The research of E. Yu. Blagoveshchenskaya and E. P. Gudkova was carried out within the framework of the theme of the state assignment of Lomonosov Moscow State University (no. 121032300081-7).

References / Литература

- Aptroot A., Edwards B. 2009. *Fellhaneropsis* Sérus et Coppins. *The lichens of Great Britain and Ireland*. London: 401–402.
- Biazrov L. G. 1996. The lichen diversity in Moscow city. *Bulletin of Moscow Society of Naturalists. Biological series* 101(3): 68–77. [Бязров Л. Г. 1996. Видовое разнообразие лишайников Москвы. *Бюллетень Московского общества испытателей природы. Отдел биологический* 101(3): 68–77].
- Biazrov L. G. 2009. Species composition of lichen biota of the Moscow Region. Version 2. http://www.sevin.ru/laboratories/biazrov_msk.html (Date of access: 8 XII 2023). [Бязров Л. Г. 2009. Видовой состав лишайнобиоты Московской области. Версия 2. http://www.sevin.ru/laboratories/biazrov_msk.html (Дата обращения: 8 XII 2023)].
- Biazrov L. G. 2012. Species composition of the lichen biota of the territory of Greater Moscow. Version 1. http://www.sevin.ru/laboratories/biazrov_big_msk_2012.html (Date of access: 8 XII 2023). [Бязров Л. Г. 2012. Видовой состав лишайнобиоты территории Большой Москвы. Версия 1. http://www.sevin.ru/laboratories/biazrov_big_msk_2012.html (Дата обращения: 8 XII 2023)].

- Biazrov L. G. 2015. Spatial distribution of an index of atmospheric purity on area integrated to Moscow city territory in 2012 determined by parameters of epiphytic lichen biota. *Bulletin of Moscow Society of Naturalists. Biological series* 120(4): 51–59. [Бязров Л. Г. 2015. Пространственное распределение на присоединенной в 2012 г. к Москве территории индекса чистоты атмосферы, определенного по показателям эпифитной лишенобиоты. *Бюллетень Московского общества испытателей природы. Отдел биологический* 120(4): 51–59].
- Coppins B. J., James P. W. 1978. New or interesting British lichens II. *The Lichenologist* 10(2): 179–207. <https://doi.org/10.1017/S0024282978000298>
- Elenkin A. A. 1906–1911. *Flora lichainikov Srednei Rossii* [Lichen flora of Media Russia]. Parts 1–4. Yuryev: 682 p. [Еленкин А. А. 1906–1911. *Флора лишайников Средней России*. Ч. 1–4. Юрьев: 682 с.].
- Gagarina L. V., Chesnokov S. V., Konoreva L. A., Stepanchikova I. S., Yatsyna A. P., Kataeva O. A., Notov A. A., Zhurbenko M. P. 2020. Lichens of the former manors in the Smolensk Region of Russia. *Novosti sistematiki nizshikh rastenii* 54(1): 93–116. <https://doi.org/10.31111/nsnr/2020.54.1.93>
- Golubkova N. S. 1962. *Flora lichainikov Moskovskoi oblasti*. Kand. Diss. [Lichen flora of the Moscow Region]. Leningrad: 1002 p. [Голубкова Н. С. 1962. *Флора лишайников Московской области*. Дисс. ... канд. биол. наук. Л.: 1002 с.].
- Guzow-Krzemińska B., Czarnota P., Łubek A., Kukwa M. 2016. *Micarea soralifera* sp. nov., a new sorediate species in the *M. prasina* group. *The Lichenologist* 48(3): 161–169. <https://doi.org/10.1017/S0024282916000050>
- Himelbrant D. E., Kuznetsova E. S. 2009. Lichens. *Survey of biologically valuable forests in North-Western European Russia. Vol. 2. Identification manual of species to be used during survey at stand level*. St. Petersburg: 93–138. [Гимельбрант Д. Е., Кузнецова. Е. С. 2009. Лишайники. *Выявление и обследование биологически ценных лесов на Северо-Западе Европейской части России. Т. 2. Пособие по определению видов, используемых при обследовании на уровне выделов*. СПб.: 93–138.]
- Himelbrant D. E., Notov A. A., Stepanchikova I. S. 2011. Contributions to the lichen flora of the Tver Region. *Bulletin of Tver State University. Series: Biology and Ecology* 21(2): 157–167. [Гимельбрант Д. Е., Нотов А. А., Степанчикова И. С. 2011. Дополнения к лишенофлоре Тверской области. *Вестник Тверского государственного университета. Серия: Биология и экология* 21(2): 157–167].
- Hydrometeorological center of Russia. 2023. <https://meteoinfo.ru/> (Date of access: 28 XII 2023). [Гидрометцентр России. 2023. <https://meteoinfo.ru/> (Дата обращения: 28 XII 2023)].
- Index Fungorum. 2023. <http://www.indexfungorum.org/names/names.asp> (Date of access: 26 XII 2023).
- Kolosova N. N., Churilova E. A. 2004. *Atlas. Moskovskaya oblast'* [Atlas. Moscow Region]. Moscow: 48 p. [Колосова Н. Н., Чурилова Е. А. 2004. *Атлас. Московская область*. М.: 48 с.].
- Konoreva L. A., Muchnik E. E. 2013. Lichens of the Aidarsky area of the Rovensky Nature Park and its environs (Belgorod Region). *Flora i rastitel'nost' Tsentral'nogo Chernozem'ya – 2013. Materialy regional'noi nauchnoi konferentsii* [Flora and vegetation of the Central Chernozem Region – 2013: Materials of the regional scientific conference]. Kursk: 215–220. [Конорева Л. А., Мучник Е. Э. 2013. Лишайники участка Айдарский Природного парка Ровеньский и его окрестностей (Белгородская область). *Флора и растительность Центрального Черноземья – 2013: Материалы региональной научной конференции*. Курск: 215–220].
- Korachevskaya E. G. 1977. Thelidiaceae. *Opredelitel' lichainikov SSSR. Вып. 4. Verrucariaceae – Pilocarpaceae* [Handbook of lichens of the USSR. Iss. 4. Verrucariaceae – Pilocarpaceae]. Leningrad: 54–65. [Копачевская Е. Г. 1977. Thelidiaceae. *Определитель лишайников СССР. Вып. 4. Верукарриевые – Пилокарповые*. Л.: 54–65].
- Muchnik E. E. 2012. Contribution to the lichen flora of the Lipetsk Region and Central Chernozem Region. *Sostoyanie redkikh vidov rastenii i zhivotnykh Lipetskoi oblasti* [The state of rare

- species of plants and animals in the Lipetsk Region]. Voronezh: 19–30. [Мучник Е. Э. 2012. Дополнения к лишенофлоре Липецкой области и Центрального Черноземья. *Состояние редких видов растений и животных Липецкой области*. Воронеж: 19–30].
- Muchnik E. E. 2015. Lichens as indicators of forest ecosystems in the Center of European Russia *Forest Engineering Journal* 5(3): 65–76. [Лишайники как индикаторы состояния лесных экосистем центра Европейской России]. *Лесотехнический журнал* 5(3): 65–76]. <https://doi.org/10.12737/14154>
- Muchnik E. E. 2016a. Additions to lichen biota of Moscow Region. *Uchenye zapiski Petrozavodskogo gosudarstvennogo universiteta* 8(161): 52–57. [Мучник Е. Э. 2016а. Дополнения к лишенобиоте Московского региона. *Ученые записки Петрозаводского государственного университета* 8(161): 52–57].
- Muchnik E. E. 2016b. Lichen biota of Orel Region (Central Russia): an annotated checklist. *Phytodiversity of Eastern Europe* 10(3): 6–28. [Мучник Е. Э. 2016b. Конспект лишенобиоты Орловской области (Центральная Россия). *Фиторазнообразие Восточной Европы* 3: 6–28].
- Muchnik E. E. 2020. Contribution to the lichen biota of the Bryansk Region (Russia). *Novosti sistematiki nizshikh rastenii* 54(2): 441–451. [Мучник Е. Э. 2020. Дополнения к лишенобиоте Брянской области (Россия). *Новости систематики низших растений* 54(2): 441–451]. <https://doi.org/10.31111/nsnr/2020.54.2.441>
- Muchnik E. E. 2021. Additions to the lichen flora of the “Kulikovo Pole” Museum-Reserve (Tula Region). *Botanicheskii zhurnal* 106(11): 1113–1122. [Мучник Е. Э. 2021. Дополнения к лишенофлоре музея-заповедника «Куликово поле» (Тульская область). *Ботанический журнал* 106(11): 1113–1122]. <https://doi.org/10.31857/S0006813621110065>
- Muchnik E. E. 2023. Contributions to the lichen flora of the Tula Region. *Botanicheskii zhurnal* 108(12): 101–110. [Мучник Е. Э. 2023. Дополнения к лишенобиоте Тульской области. *Ботанический журнал* 108(12): 101–110]. <https://doi.org/10.31857/S0006813623120074>
- Muchnik E. E., Konoreva L. A., Himelbrant D. E. 2007. New lichen species of the Central Chernozem Region. *Botanicheskii zhurnal* 91(5): 760–763. [Мучник Е. Э., Конорева Л. А., Гимельбрант Д. Е. 2007. Дополнения к флоре лишайников Центрального Черноземья. *Ботанический журнал* 91(5): 760–763].
- Muchnik E. E., Konoreva L. A., Chesnokov S. V., Cherepenina D. A. 2022a. Lichenological findings of new and rare species in Central Russia. *Botanicheskii zhurnal* 107(11): 81–89. [Мучник Е. Э., Конорева Л. А., Чесноков С. В., Черепенина Д. А. 2022а. Лишенологические находки новых и редких видов в Центральной России. *Ботанический журнал* 107(11): 81–89]. <https://doi.org/10.31857/S0006813622110047>
- Muchnik E. E., Otte V., Tsurykau A., Breuss O., Gerasimova J. V., Cherepenina D. A. 2022b. New and otherwise noteworthy records of lichenized and lichenicolous fungi from central European Russia II. *Herzogia* 35(2): 494–509. <https://doi.org/10.13158/hea.35.2.2022.494>
- Notov A. A. 2010. *Natsional'nyi park “Zavidovo”: Sosudistye rasteniya, mokhoobraznye, lishainiki. Вып. VIII: Yubileinye nauchnye chteniya* [Zavidovo National Park: Vascular plants, bryophytes, lichens. Iss. VIII: Anniversary scientific readings]. Moscow: 432 p. [Нотов А. А. 2010. *Национальный парк «Завидово»: Сосудистые растения, мохообразные, лишайники. Вып. VIII: Юбилейные научные чтения*. М.: 432 с.].
- Notov A. A. 2019. Some results of floristic research in the national park over the past five years (2014–2018). *Natsional'nyi park “Gosudarstvennyi kompleks “Zavidovo” — 90 let. Вып. XI: Yubileinye nauchnye chteniya* [National Park “State complex “Zavidovo” — 90 years. Iss. XI: Anniversary scientific readings]. Moscow: 47–76. [Нотов А. А. 2019. Некоторые итоги флористических исследований в национальном парке за последние пять лет (2014–2018 гг.). *Национальный парк «Государственный комплекс «Завидово» — 90 лет. Вып. XI: Юбилейные научные чтения*. М.: 47–76].
- Notov A. A., Himelbrant D. E., Urbanavichus G. P. 2011. *Annotirovannyi spisok likhenoflory Tverskoi oblasti* [Annotated list of the lichen flora of the Tver Region]. Tver: 124 p. [Нотов А. А.,

- Гимельбрант Д. Е., Урбанавичюс Г. П. 2011. *Аннотированный список лишенофлоры Тверской области*. Тверь: 124 с.].
- Notov A. A., Himelbrant D. E., Stepanchikova I. S. 2014. New materials to the lichen flora of Tver Region. *Bulletin of Tver State University. Series: Biology and Ecology* 2: 136–144. [Нотов А. А., Гимельбрант Д. Е., Степанчикова И. С. 2014. Новые материалы о лишенофлоре Тверской области. *Вестник Тверского государственного университета. Серия: Биология и экология* 2: 136–144].
- Orange A., James P. W., White F. J. 2010. *Microchemical methods for the identification of lichens*. London: 101 p.
- Paukov A. G., Teptina A. Y. 2012. New records of lichens from Middle Urals, Russia. *Folia Cryptogamica Estonica* 49: 39–43.
- Pchelkin A. V. 2005. Comparison of lichen flora of Moscow and Prioksko-Terrasny Nature Reserve. *Ekosistemy Prioksko-Terrasnogo biosfernogo zapovednika* [Ecosystems of Prioksko-Terrasny Biosphere Reserve]. Pushchino: 95–104. [Пчелкин А. В. 2005. Сравнение флоры лишайников Москвы и Приокско-Тerrasного заповедника. *Экосистемы Приокско-Тerrasного биосферного заповедника*. Пушчино: 95–104].
- Pchelkin A. V., Pchelkina T. A. 2012. The first data on lichen biota of Nature Park “Skhodnya River valley in Kurkino” (Moscow). *Novosti sistematiki nizshikh rastenii* 46: 190–196. [Пчелкин А. В., Пчелкина Т. А. 2012. Первые сведения и лишенобиоте природного парка «Долина реки Сходни в Куркино» (Москва). *Новости систематики низших растений* 46: 190–196]. <https://doi.org/10.31111/nsnr/2012.46.190>
- Petrov V. V. 1968. New scheme of geobotanical zoning of the Moscow Region. *Moscow University Biological Science Bulletin. Series 6: Biology, edaphology* 5: 44–50. [Петров В. В. 1968. Новая схема геоботанического районирования Московской области. *Вестник Московского государственного университета. Серия 6: Биология, почвоведение* 5: 44–50].
- Pykälä J., Stepanchikova I. S., Himelbrant D. E., Kuznetsova E. S., Alexeeva N. M. 2012. The lichen genera *Thelidium* and *Verrucaria* in the Leningrad Region (Russia). *Folia Cryptogamica Estonica* 49: 45–57.
- Stepanchikova I. S., Gagarina L. V. 2014. Collection, identification and storage of lichen collections. *Flora lichainikov Rossii: Biologiya, ekologiya, raznoobrazie, rasprostranenie i metody izucheniya lichainikov* [The lichen flora of Russia: biology, ecology, diversity, distribution, and methods for studying lichens]. Moscow; St. Petersburg: 204–219. [Степанчикова И. С., Гагарина Л. В. 2014. Сбор, определение и хранение лишенологических коллекций. *Флора лишайников России: Биология, экология, разнообразие, распространение и методы изучения лишайников*. М.; СПб.: 204–219].
- Suslova E. G. 2019. Forests of Moscow Region. *Ecosystems: ecology and dynamics* 3(1): 119–190. [Суслова Е. Г. 2019. Леса Московской области. *Экосистемы: экология и динамика* 3(1): 119–190].
- Tolpysheva T. Yu. 2020. Lichens of the “Porechie Park” and their protection. *Bulletin of Moscow Society of Naturalists. Biological series* 125(5): 52–57. [Толпышева Т. Ю. 2020. Лишайники «Парка Поречье» и их охрана. *Бюллетень Московского общества испытателей природы. Отдел биологический* 125(5): 52–57].
- Tomin M. P. 1926. Materials for the lichen flora of the Voronezh province. *Zapiski Voronezhskogo sel'skokhozyaistvennogo instituta* 5: 109–122. [Томин М. П. 1926. Материалы к лишайниковой флоре Воронежской губернии. *Записки Воронежского сельскохозяйственного института* 5: 109–122].
- Urbanavichene I. N., Urbanavichus G. P. 2015. Additions to lichen flora of Mordovia State Preserve, Republic of Mordovia, and Middle Russia. *Uchenye zapiski Petrozavodskogo gosudarstvennogo universiteta. Biologicheskie nauki* 8(153): 75–79. [Урбанавичене И. Н., Урбанавичюс Г. П., 2015. Дополнения к лишенофлоре Мордовского заповедника, Республики Мордовия и Средней России. *Ученые записки Петрозаводского государственного университета. Биологические науки* 8(153): 75–79].

- Urbanavichene I. N., Urbanavichus G. P. 2021. Additions to the lichen flora of the Kologriv Forest Reserve and Kostroma Region. *Turczaninowia* 24(2): 28–41. <https://doi.org/10.14258/turczaninowia.24.2.4>
- Urbanavichus G. P., Lavrinenko O. V., Urbanavichene I. N. 2009. The lichens of Dolgii and adjacent islands of the Barents Sea. *Botanicheskii zhurnal* 94(5): 656–677. [Урбанавичюс Г. П., Лавриненко О. В., Урбанавичене И. Н. 2009. Лишайники острова Долгий и близлежащих островов юго-востока Баренцева моря. *Ботанический журнал* 94(5): 656–677].
- Westberg M., Moberg R., Myrdal M., Nordin A., Ekman S. 2021. *Santesson's checklist of Fennoscandian lichen-forming and lichenicolous fungi*. Uppsala: 933 p.
- Zhdanov I. S., Volosnova L. F. 2012. Contributions to the lichen flora of Meshchyora lowland (within Vladimir and Ryazan regions). *Novosti sistematiki nizshikh rastenii* 46: 145–160. [Жданов И. С., Волоснова Л. Ф. 2012. Материалы к лишенофлоре Мещерской низменности (в пределах Владимирской и Рязанской областей). *Новости систематики низших растений* 46: 145–160]. <https://doi.org/10.31111/nsnr/2012.46.145>