

## LICHENICOLOUS FUNGI NEW TO ORENBURG REGION, SOUTHERN PART OF EUROPEAN RUSSIA

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### Abstract

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Twenty two species of lichenicolous fungi are reported as new to Orenburg region. Of these, *Didymocyrtis clado-niicola* is new to European Russia; *Lichenocodium lichenicola*, *Marchandiomyces corallinus*, *Merismatium decolorans*, *Phoma peltigerae* and *Roselliniella cladoniae* are new to the southern part of European Russia.

**Keywords:** biodiversity, distribution, forest, new records, steppe.

## INTRODUCTION

Although the diversity and distribution of lichens in Orenburg region are considered to be well known (MERKULOVA, 2006; KORCHIKOV & TRAVKIN, 2015), lichenicolous fungi remain unexplored and so far only five species have been recorded in the area, namely *Arthonia epiphyscia* Nyl., *Cercidospora epicarphi-nea* (Nyl.) Grube et Hafellner, *C. macrospora* (Uloth) Hafellner et Nav.-Ros., *Echinothecium reticulatum* Zopf and *Muellerella pygmaea* (Körb.) D.Hawksw. (MERKULOVA & URBANAVICHUS, 2006).

In this contribution, we report 22 species of lichenicolous fungi new to Orenburg region, mainly from Buzulukskij Bor National Park. Of these, seven species are recorded as new to European Russia or to the southern part of European Russia (Es) (ANDREEV & HIMELBRANT, 2014).

## MATERIALS AND METHODS

### Study area

Orenburg region is located on the border of Europe and Asia within 54°24'–50°30' N and 50°00'–62°30' E (CHIBILEV, 1996). Its territory is mainly covered by steppe vegetation (Fig. 1), but rather includes a small number of isolated forest areas.

Buzulukskij Bor National Park (NP) is the largest isolated forest area within the steppes between the Volga and Ural Mountains. It is located on the borderline of Orenburg and Samara regions (Fig. 2). The climate of the study area is continental. The average annual temperature is 3.6°C. The mean temperature ranges from -14°C in January to 34°C in July. The mean annual precipitation is 530 mm (CHIBILEV, 2012). Forest vegetation is mainly dominated by *Pinus sylvestris* (Fig. 3), the other common trees are

*Quercus robur*, *Betula pendula*, *Populus tremula* and *Alnus glutinosa*. A large number of meadows and glades are composed of various types of perennial herbaceous plants (CHIBILEV, 2008).

### Data sampling

The material was collected mainly by the second and the third authors during their field studies in 2006–2016. Cited specimens are deposited at the Herbarium of Samara National Research University (SMR). The material was examined using dissecting microscope MicroMed MC-2 and compound microscope MicMed 6; valuable and taxonomically critical material was additionally studied using Nikon SMZ 745 and Nikon Eclipse 80i microscopes. Microscopic examination was done in water, 10% KOH (K), Lugol's iodine, directly (I) or after a KOH pre-treatment (K/I). Measurements were taken from water mount. Values are indicated as (minimum–){X–SD}–{X+SD}(–maximum), where X is the arithmetic mean and SD – the corresponding standard deviation followed by the number of measurements.

### List of localities

The map of sampling localities included in the present study is given in Fig. 1.

Russia, Orenburg Region

1. Buzulukskij district, Buzulukskij Bor NP, the Cheluskinskoye Forest, bank of the River Karachev Mushtaj, 53°07'49.07" N, 52°17'45.82" E, black alder forest, 14 June 2016. Leg. V.P. Travkin;

2. Buzulukskij district, Buzulukskij Bor NP, the Cheluskinskoye Forest, 3 km S of Karachevo village, 53°06'54.10" N, 52°16'50.60" E, pine forest, 15 August 2006. Leg. E.S. Korchikov;

3. Buzulukskij district, Buzulukskij Bor NP, the Borovoye-Opytnoye Forest, 53°02'02.16" N, 52°09'11.82" E, oak-linden forest, 26 June 2015. Leg. V.P. Travkin;

4. Buzulukskij district, Buzulukskij Bor NP, the Borovoye-Opytnoye Forest, close to Lake Studenoye, 53°02'01.78" N, 52°08'56.02" E, black alder forest, 3 September 2014. Leg. V.P. Travkin;

5. Buzulukskij district, Buzulukskij Bor NP, the Partizanskoye Forest, 53°00'15.11" N, 52°08'53.79" E, pine forest, 23 July 2016. Leg. V.P. Travkin;

6. Buzulukskij district, Buzulukskij Bor NP, the Borovoye-Opytnoye Forest, 53°00'09.01" N,



Fig. 1. Feather grass steppe, dominant vegetation in Orenburg region

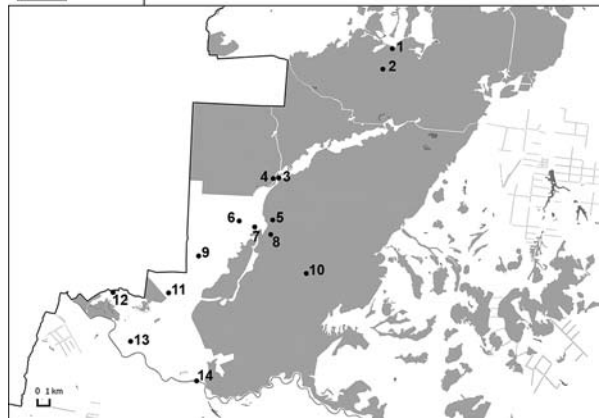


Fig. 2. Location of the study area (Orenburg Region and Buzulukskij Bor National Park)



Fig. 3. Pine wood in Buzulukskij Bor National Park

52°06'16.01" E, pine forest, 28 August 2014. Leg. V.P. Travkin;

7. Buzulukskij district, Buzulukskij Bor NP, the Borovoye-Opytnoye Forest, 52°59' N, 52°07' E, 27 June 2015. Leg. V.P. Travkin (7a – pine forest, 7b – broadleaved forest); 15 June 2011. Leg. E.S. Korchikov (7c – broadleaved forest);

8. Buzulukskij district, Buzulukskij Bor NP, the Partizanskoye Forest, top of a ridge, 52°59'30.11" N, 52°08'40.43" E, pine forest, 15 June 2011. Leg. E.S. Korchikov;

9. Buzulukskij district, Buzulukskij Bor NP, the Borovoye-Opytnoye Forest, 52°58'36.74" N, 52°03'24.56" E, pine forest, 5 August. Leg. E.S. Korchikov;

10. Buzulukskij district, Buzulukskij Bor NP, the Partizanskoye Forest, 52°58'94.10" N, 52°10'07.40" E, pine forest, 21 June 2013. Leg. E.S. Korchikov;

11. Buzulukskij district, Buzulukskij Bor NP, the Koltubanovskoye Forest, 52°57'12.90" N, 52°01'17.90" E, pine forest, 3 August 2014. Leg. E.S. Korchikov;

12. Buzulukskij district, Buzulukskij Bor NP, the Koltubanovskoye Forest, 52°57'18.12" N, 51°57'58.63" E, broadleaved forest, 2 August 2014. Leg. E.S. Korchikov;

13. Buzulukskij district, Buzulukskij Bor NP, the Koltubanovskoye Forest, 52°54'46.53" N,

51°58'29.01" E, linden forest, 27 June 2015. Leg. V.P. Travkin;

14. Buzulukskij district, Buzulukskij Bor NP, the Koltubanovskoye Forest, 52°53'3.09" N, 52°03'16.31" E, aspen forest, 25 September 2013. Leg. V.P. Travkin;

15. Pervomajskij district, 4 km E of Kurlin village, 51°48'46.33" N, 51°02'1.23" E, fescue steppe, 25 May 2010. Leg. E.S. Korchikov.

### The species

*Abrothallus suecicus* (Kirschst.) Nordin (anamorph) – 3: on *Ramalina pollinaria* (thallus) on *Quercus robur* (SMR-1165).

*Athelia arachnoidea* (Berk.) Jülich – 5: on *Xanthoria parietina* and *Physcia adscendens* on lignum (SMR-1178). This occasionally lichen-inhabiting fungus often inhabits algae, mosses, leaf litter, bark and wood (YURCHENKO & GOLUBKOV, 2003).

*Clypeococcum hypocenomycis* D.Hawksw. – 7c: on *Hypocenomyce scalaris* on *Salix alba* (SMR); 8, 11: on *H. scalaris* on *Pinus sylvestris* (SMR-506, SMR-508).

*Cornutispora lichenicola* D.Hawksw. et B.Sutton – 10: on *Parmelia sulcata* (thallus) on *Betula pendula* (SMR-665).

*Didymocyrtis cladoniicola* (Diederich et al.) Ertz et Diederich – 11: on *Cladonia coniocraea* (squamules) on lignum (SMR-863). New to European Rus-

sia. In Russia, the species has been previously known from single locality in Ural Mountains (URBANAVICHUS & URBANAVICHENE, 2011). Our sample has simple, hyaline, ellipsoid, apically rounded conidia,  $(4.0-4.4-5.1(-5.5) \times (2.0-2.2-2.8(-3.2)) \mu\text{m}$ , l/b  $(1.5-1.7-2.1(-2.7))$ ,  $n = 50$ . Another member of the genus parasitizing *Cladonia* species, *D. foliaceiphila* (Diederich et al.) Ertz et Diederich, differs by longer conidia measuring  $(5.0-5.8-7.1(-7.5) \times (2.0-2.2-2.7(-3.0)) \mu\text{m}$  (DIEDERICH et al., 2007; ERTZ et al., 2015; HAFELLNER, 2015). The species can be confused with *Phoma grumantiana* Zhurb. et Diederich, which also inhabits species of *Cladonia*, but it has relatively narrower conidia measuring  $(3.2-4.1-5.2(-6.2) \times (1.5-1.7-2.2(-2.8)) \mu\text{m}$ , l/b  $(1.3)2.0-2.8(-3.4)$  (DIEDERICH et al., 2007). *Didymocyrtis cladoniicola* has unusual low host specificity being reported from various species of *Cladonia* as well as from *Flavoparmelia*, *Parmelina*, *Ramalina*, *Squamarina* and calcareous outcrops adjacent to the host species (ERTZ et al., 2015; HAFELLNER, 2015). Furthermore, this species was detected inducing leaf necrosis and twig dieback in the olive crop (*Olea europaea* var. *sativa*) based on DNA sequencing (LO PICCOLO et al., 2014). *Cladonia coniocraea* represents new host species for this fungus.

***Heterocephalacria physciacearum*** (Diederich) Millanes et Wedin – 1: on *Physcia stellaris* (thallus) on *Padus avium* (SMR-1174); 7a: on *Physcia ascendens* (thallus) on *Malus pumila* (SMR-1171).

***Illosporopsis christiansenii*** (B.L.Brady et D.Hawksw.) D.Hawksw. – 7a: on *Physcia stellaris* (thallus and apothecia) on *Malus pumila* (SMR-1172). The species was erroneously reported from Orenburg region by KORCHIKOV et al. (2014); the specimens cited in that paper appeared to be *Marchandiomyces corallinus*. Distribution in Es outside of Orenburg region: Samara region (TSURYKAU & KORCHIKOV, 2017). This widespread lichenicolous fungus often confined to nitrogen-rich habitats is characterized by coiled conidia aggregated in soft, pink sporodochia.

***Intralichen christiansenii*** (D.Hawksw.) D.Hawksw. et M.S.Cole – 14: on *Caloplaca* sp. (apothecia) on *Populus tremula* (SMR-1169).

***Lichenochora obscuroides*** (Linds.) Triebel et Rambold – 7b, 7c: on *Phaeophyscia orbicularis* (thallus) on *Salix alba* (SMR-171, SMR-1170); 14: on *P. orbicularis* on *Populus tremula* (SMR-168).

***Lichenocodium erodens*** M.S.Christ. et D.Hawksw. – 1: on *Parmelia sulcata* and *Physcia aipolia* on *Alnus glutinosa* (SMR-1168); on *Lecanora symmetrica* (thallus and apothecia) on *Padus avium* (SMR-1173); on *Lecanora* sp. (thallus) on *A. glutinosa* (SMR-1097); 2: on *Pseudevernia furfuracea* on *Pinus sylvestris* (SMR-890); 7a: on *Evernia mesomorpha* on *P. sylvestris* (SMR s. n.); 11: on *Hypogymnia tubulosa* on *Betula pendula* (SMR-1167).

***Lichenocodium lecanorae*** (Jaap) D.Hawksw. – 4: on thalli of *Lecanora varia* and *Parmelia sulcata* on *Alnus glutinosa* (SMR-1166).

***Lichenocodium lichenicola*** (P.Karst.) Petr. et Syd. – 1: on *Physcia aipolia* (thallus and apothecia) on *Alnus glutinosa* (SMR-1177). New to Es. In Russia, the species has been previously known from Tula region and Republic of Karelia (ALSTRUP et al., 2005; ZHURBENKO & GUDOVICHEVA, 2013). Our sample has black, immersed in host thallus pycnidia  $100-150 \mu\text{m}$ , hyaline conidiogenous cells  $8-9.5 \mu\text{m}$ , and brown, elongate-ellipsoid, base tapering, truncated, coarsely verrucose conidia  $5-7 \times 3-4 \mu\text{m}$ ,  $n = 15$ . Other members of the genus mainly differ in size of their pycnidia and conidia (COLE & HAWKSWORTH, 2004). Additionally, conidia in *L. lichenicola* are coarsely verrucose and characteristically shaped. *Lichenocodium lichenicola* also resembles *Lichenodiplis fallaciosa* (Hafellner et Kalb) Diederich, which differs by smooth conidia and brown conidiogenous cells (HAWKSWORTH, 1981).

***Lichenodiplis lecanorae*** (Vouaux) Dyko et D.Hawksw. – 7a: on *Physcia stellaris* (thallus) on *Malus pumila* (SMR-1180).

***Lichenostigma maureri*** Hafellner – 7c: on *Usnea* sp. on *Salix alba* (SMR); 11: on *Usnea hirta* on *Pinus sylvestris* (SMR).

***Marchandiomyces corallinus*** (Roberge) Diederich et D.Hawksw. – 14: on *Physconia enteroxantha* on *Acer tataricum* (SMR-503); on *Phaeophyscia orbicularis* (thallus) on *A. tataricum* (SMR-504). New to Es being reported from Kaliningrad region, Karachayevo-Circassian Republic, Republics of Adygeya and Buryatia, and Jewish Autonomous Region (DEDKOV et al., 2007; ZHURBENKO 2008, 2014; ZHURBENKO & KOBZEVA, 2014, 2016). The fungus can readily be identified by bright pink, initially immersed coralloid bulbils (ETAYO & DIEDERICH, 1996). It can be confused with *Illosporopsis christiansenii*

and *Erythrimum aurantiacum* (Lasch) D.Hawksw. et A.Henrici. The former forms pink sporodochia containing set of coiled conidia while the latter has pale orange, superficial bulbils developing basidia and basidiospores (DIEDERICH et al., 2003).

***Merismatium decolorans*** (Rehm ex Arnold) Triebel – 12: on *Cladonia fimbriata* (squamules) on lignum (SMR). New to Es. This fungus is widespread in Russia and known from Murmansk Region, Severnaya Zemlya, Yakutiya, Putorana Plateau, Trans-Baikal Territory and Chukotka (ZHURBENKO & HAFELLNER, 1999; ZHURBENKO, 2001, 2009a, 2009b; ZHURBENKO et al., 2016). Our sample has black, sessile perithecia associated with goniocysts, 8-spored asci, and 3-septate, pale brown to brown ascospores,  $(9.0-9.5-10.8(-12.0)) \times (4.0-4.1-4.6(-5.0)) \mu\text{m}$ ,  $l/b = (1.8-2.2-2.6(-2.7))$ ,  $n = 25$ , rarely with a longiseptum in a central segment. *Merismatium cladonicicola* Alstrup, *M. coccotremicola* Etayo, *M. heterophractum* (Nyl.) Vouaux and *M. nigrillum* (Nyl.) Vouaux also parasitize *Cladonia* species, but can be separated by ascospore dimensions, which are  $13-16.5 \times 5.5-7 \mu\text{m}$  in *M. cladonicicola*,  $10.5-14.5 \times 5.5-7 \mu\text{m}$  in *M. coccotremicola*,  $(8-10-13(-16)) \times (4-5-6.5(-7.5)) \mu\text{m}$  in *M. heterophractum* and  $(14-15-24.5(-32)) \times (6.5-8-12(-15)) \mu\text{m}$  in *M. nigrillum* (TRIEBEL, 1989; ALSTRUP, 1997; ETAYO & SANCHO, 2008; ZHURBENKO, 2009a; ZHURBENKO & DILLMAN, 2010). Furthermore, *M. cladonicicola* has smaller perithecia, *M. heterophractum* is not associated with goniocysts, and *M. nigrillum* has submuriform to muriform ascospores. ZHURBENKO & KOBZEVA (2014) reported *Merismatium* cf. *cladonicicola* Alstrup from Russia, which differs from *M. decolorans* by hyaline to pale brown 0–3-septate ascospores.

***Muellerella lichenicola*** (Sommerf. ex Fr.) D.Hawksw. – 7b: on *Physconia distorta* (thallus and apothecia) on *Salix alba* (SMR).

***Phoma peltigerae*** (P.Karst.) D.Hawksw. – 15: on *Peltigera lepidophora* on soil (SMR-1177). New to Es. The species is known throughout Russia being reported from Murmansk and Tula regions (ZHURBENKO, 2009b; ZHURBENKO & GUDOVICHEVA 2013), Republic of Karelia (ALSTRUP et al., 2005; ZHURBENKO, 2009b); Karachayevo-Circassian Republic (ZHURBENKO & KOBZEVA, 2014), Krasnoyarsk Territory (ZHURBENKO, 2009b) and Yakutiya (ZHURBENKO & VERSHININA, 2014).

Conidia in our specimen are simple, hyaline, ellipsoid,  $(4.5-4.7-5.8(-6.0)) \times (2.0-2.4-2.8(-3.0)) \mu\text{m}$ ,  $l/b = (1.6-1.8-2.3(-2.6))$ ,  $n = 25$ . Other members of the genus parasitizing *Peltigera* species, *Phoma epiparmelia* Vouaux and *P. lobariae* Diederich & Etayo, mainly differ in dimensions of conidia, which are  $3.5-4.5 \times 2-3 \mu\text{m}$  in *P. epiparmelia* and  $3-4 \times 2.5-3 \mu\text{m}$  in *P. lobariae* (HAWKSWORTH, 1981; ETAYO & DIEDERICH, 1995; MARTINEZ & HAFELLNER, 1998).

***Roselliniella cladoniae*** (Anzi) Matzer et Hafellner – 6: on *Cladonia macilenta* (squamules) on *Pinus sylvestris* (SMR-1176); 11: on *C. rangiferina* (podetia) on soil (SMR-1179). New to Es. The fungus is widespread in Russia being known from Magadan and Murmansk regions, Republics of Adygeya, Bashkortostan, Mordovia, Yakutiya as well as Kamchatka and Krasnoyarsk Territories (ZHURBENKO & ALSTRUP, 2004; ZHURBENKO, 2009b; URBANAVICHUS & URBANAVICHENE, 2011; ZHURBENKO et al., 2012; ZHURBENKO & VERSHININA, 2014; ZHURBENKO & ZHELUDEVA, 2015; ZHURBENKO & KOBZEVA, 2016; URBANAVICHENE & URBANAVICHUS, 2016). The studied material has pyriform, superficial perithecia up to  $400 \mu\text{m}$  in diameter, covered by brown, long hyphae, 2-spore asci and ellipsoid, simple ascospores,  $32-38 \times 12-13.5 \mu\text{m}$ ,  $n = 10$ , which are colourless and halonate when young, but brown and non-halonate when mature. A characteristic hyphomycete (ZHURBENKO & PINO-BODAS, 2017) was also found in our material. Among the cladonicolous taxa, *Roselliniella cladoniae* resembles both *Biciliopsis cladoniae* Zhurb., Pino-Bodas & Diederich and *Coniochaeta* sp. (ZHURBENKO & PINO-BODAS, 2017), but these species have setose ascomata. Additionally, spores in *Biciliopsis cladoniae* are bicaudate with tail-like filiform appendages, and smaller in *Coniochaeta* sp., measuring  $(7.9-8.4-10.6(-12.9)) \times (4.6-6.3-9.1(-11.5)) \mu\text{m}$ .

***Taeniolella beschiana*** Diederich – 2: on *Cladonia phyllophora* (podetia) on soil (SMR-336); 9: on *C. furcata* (podetia) on soil (SMR-314); 11: on *C. rangiferina* (podetia) on soil (SMR-1179).

***Taeniolella phaeophysciae*** D.Hawksw. – 7b: on *Phaeophyscia orbicularis* on *Salix alba* (SMR).

***Trichonectria rubefaciens*** (Ellis et Everh.) Diederich et Schroers – 13: on *Parmelia sulcata* on *Tilia cordata* (SMR).



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## EUROPINĖS RUSIJOS PIETINĖS DALIES ORENBURGO SRITIES NAUJI LICHENIZUOTI GRYBAI

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### Santrauka

Pateikiami duomenys apie dvidešimt dvi naujas Orenburgo srities lichenizuotų grybų rūšis. Iš jų *Didyrocystis cladoniicola* yra nauja europinės Rusijos dalies rūšis; *Lichenocodium lichenicola*, *Marchandiomyces corallinus*, *Merismatium decolorans*, *Phoma peltigerae* ir *Roselliniella cladoniae* yra naujos europinės Rusijos pietinės dalies rūšys.