

# New and rare lichens and allied fungi from Arkhangelsk region, North-West Russia

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**Abstract:** Thirty-one lichen-forming fungi, 12 lichenicolous fungi, and 5 non-lichenized fungi are reported as new for Arkhangelsk Region; 7 species are new for its mainland area. *Micarea fallax* is reported for the first time for Russia; *M. laeta* and *M. pusilla* are new for the European part of Russia. The second finding of *Nicropuncta rugulosa* for Russia is recorded; microconidia are first observed in this species. The records of ten species which have been included in the new edition of the Red Data Book of the Arkhangelsk Region (2020) are presented. *Nephromopsis laureri* from the Red Data Book of the Russian Federation (2008) and *Leptogium rivulare* from the IUCN Red List are reported for the first time for Arkhangelsk Region.

**Keywords:** *Leptogium rivulare*, *Micarea fallax*, *Micarea laeta*, *Micarea pusilla*, *Nephromopsis laureri*, *Nicropuncta rugulosa*, Red Data Book, Vodlozersky National Park

## INTRODUCTION

The vast territory of Arkhangelsk Region of Russia (589.9 thousand km<sup>2</sup>), including the flat area of the northern and middle boreal zone with a relatively high share of old-growth forests, the sea coast, limestone outcrops, relatively high rocky outcrops of Baltic Shield, as well as the large territory of the islands in the Arctic, suggests high species richness of lichens. The lichen diversity of Arkhangelsk Region is still poorly known compared with other regions of Russia; there is still no checklist of lichens for this territory, and therefore the corresponding chapter in the regional Red Data Book was difficult to complete for a long time. In the previous edition of the Red Data Book of the Arkhangelsk Region (Novoselov, 2008), only ten species of lichens were included. By contrast, in the neighboring Murmansk Region (Konstantinova et al., 2014), 84 species are protected; in the Republic of Karelia (Ivanter & Kuznetsov, 2007) – 77 species,

and in the Republic of Komi (Degteva, 2019) – 85 species are included.

Our earlier publications (Tarasova et al., 2015, 2016) contain detailed overview of history of lichenological studies in the territory of Arkhangelsk Region. Currently, diversity of lichens and allied fungi in Arkhangelsk Region is becoming increasingly studied (Konoreva et al., 2019b; Tarasova et al., 2019). Annually several expeditions are organized to different parts of the region. In 2019, based on detailed study of literature data, herbarium material and private data, the list of lichens including 56 species was compiled for the new edition of the Red Data Book of the Arkhangelsk Region (Anufriev et al., 2020).

Our study aims to present new and rare lichens and allied fungi from Arkhangelsk Region, North-West Russia.

## MATERIALS AND METHODS

The study is based on the materials collected during 15 expeditions in 2010–2019. Totally, 66 localities from different districts of Arkhangelsk Region were investigated (Appendix; Fig. 1).

The collected material was identified using a standard microscopic technique and spot tests. Microscopical examination of lichenicolous fungi was carried out using a Stemi 2000-CS dissecting microscope and a Zeiss Axio Imager A1 compound microscope with interference contrast, fitted with an AxioCam MRc5 digital camera. The length and breadth of ascospores are given as (min–){X–SD}–{X+SD}(–max), where “min” and “max” are the extreme observed values, X

the arithmetic mean and SD the corresponding standard deviation, followed by the number of measurements (n). The length/breadth ratio is indicated in the same way. The lichen substances of *Micarea* species were identified by a standard technique of high performance thin-layer chromatography (HPTLC) in the Laboratory of Lichenology and Bryology of Komarov Botanical Institute of RAS (St. Petersburg) using solvent system C (Orange et al., 2001). The crystalline granules of *Micarea* species were investigated by using a compound microscope with polarization filters. The cited specimens are deposited in the Herbarium of Petrozavodsk State University (PZV), Komarov Botanical Institute RAS (LE) and Komi Research Centre (SYKO).



**Fig. 1.** Collection sites (I–XXIII, detailed data are presented in Appendix 1).

## LIST OF SPECIES

The taxa are arranged in the alphabetical order; nomenclature of lichens and non-lichenized fungi mainly follows Nordin et al. (2011), nomenclature of lichenicolous fungi follows Diederich et al. (2018). For each species the localities, habitat types and substrate are listed (Appendix). The main phorophytes for listed lichens were spruce (*Picea obovata* Ledeb. & *Picea abies* (L.) Karst.), birch (*Betula pubescens* Ehrh.), aspen (*Populus tremula* L.), black alder (*Alnus glutinosa* (L.) Gaertn), bird cherry (*Prunus padus* L.), fir (*Abies sibirica* Ledeb), willow (*Salix caprea* L.) and pine (*Pinus sylvestris* L.). Lichen substances are given for TLC-analyzed species. Abbreviations and symbols: # – lichenicolous fungi; + – non-lichenized fungi; ! – new species for Arkhangelsk Region; RA – species included in the Red Data Book of Arkhangelsk Region (Anufriev et al., 2020); PZV – herbarium of Petrozavodsk State University, LE – herbarium of Komarov Botanical Institute RAS, SYKO – herbarium of Komi Research Centre; l/b – length/breadth ratio of ascospores, pol+(-) – crystals studied in polarized light are visible (or none detected).

!# ABROTHALLUS BERTIANUS De Not. – on *Melanohalea olivacea* (apothecia, thallus), V: 37, LE 310126. – This is a common subcosmopolitan species mainly reported from *Melanelixia* and *Melanohalea* (Brackel, 2014). Distribution in neighboring territories: Leningrad Region (Himmelbrant et al., 2018), Republic of Karelia (Zhurbenko & Ahti, 2005), and Yamal-Nenets Autonomous Area (Zhurbenko, 2008).

!# BACHMANNIOMYCES PUNCTUM (A. Massal.) Diederich & Pino-Bodas – on *Cladonia furcata* (basal squamules), VI: 38, LE 310124. – This is a common cosmopolitan species confined to *Cladonia* (Brackel, 2014; Zhurbenko & Pino-Bodas, 2017). Distribution in neighboring territories: Leningrad Region (Himmelbrant et al., 2013), Murmansk Region (Urbanavichus et al., 2008), Republic of Komi (Zhurbenko, 2004), and Yamal-Nenets Autonomous Area (Zhurbenko, 2008).

! BIATORA VACCINICOLA (Tønsberg) Printzen – on spruce twigs, XXI: 56, XXII: 57, SYKO. – A rare species in Russia. Distribution in Russia: Republic of Komi (Hermansson et al., 2006), and Kamchatka Territory (Himmelbrant et al., 2009).

! BIATORA VERNALIS (L.) Fr. – on mossy trunk base of spruce, I: 1, PZV. – A common boreal

species reported from most regions of Russia (Urbanavichus, 2010). Distribution in neighboring territories: Leningrad Region (Kuznetsova et al., 2007a), Republic of Karelia (Fadeeva et al., 2007), and Republic of Komi (Gruzdev et al., 2005).

! CHAENOTHECA GRACILLIMA (Vain.) Tibell – on wood of stand and fallen dead spruce and birch, less often on bark of living spruce trees, I: 2–9, PZV, on dead wood of spruce stump, XXII: 57, SYKO; RA. – A rare, specialist species, i.e. adapted to specific habitat requirements of biologically valuable old-growth forests (Andersson et al., 2009) and is vulnerable to habitat disturbance (managed forests). Distribution in neighboring territories: Murmansk Region (Urbanavichus et al., 2008), Leningrad Region (Kuznetsova et al., 2007a), Republic of Karelia (Fadeeva et al., 2007), Kostroma Region (Urbanavichene & Urbanavichus, 2019), and Republic of Komi (Hermansson et al., 1998).

! CHAENOTHECA SPHAEROCEPHALA Nád. – on branches of spruce, I: 10, IV: 35, PZV, RA. – Distribution in neighboring territories: Kostroma Region (Kuznetsova & Skazina, 2010), Leningrad Region (Kuznetsova et al., 2007b; Sorokina et al., 2017), and Republic of Komi (Gruzdev et al., 2005).

CHAENOTHECA PHAEOCEPHALA (Turner) Th. Fr. – on bark of spruce, I: 2, 11–12, 7, 13–15, IV: 36, PZV, RA. – This species was previously known in Arkhangelsk Region only from Onezhsky District (Tarasova et al., 2019). Distribution in neighboring territories: Republic of Karelia (Fadeeva et al., 2007), Republic of Komi (Pystina, 2003), and Leningrad Region (Kuznetsova et al., 2007a).

! CHAENOTHECA XYLOXENA Nád. – on dead wood, I: 5, 7, PZV. – A common species reported from most regions of Russia (Urbanavichus, 2010). Distribution in neighboring territories: Murmansk Region (Urbanavichus et al., 2008), Leningrad Region (Himmelbrant, 2016), Republic of Karelia (Fadeeva et al., 2007), and Republic of Komi (Hermansson et al., 1998).

+ CHAENOTHECOPSIS FENNICA (Laurila) Tibell. – on stump of pine, XXIII: 60, SYKO. – A rare, specialist species of biologically valuable old-growth forests (Andersson et al., 2009). Formerly known in Arkhangelsk Region only from Onezhsky District (Tarasova et al., 2019). Distribution in neighboring territories: Republic of Karelia

(Tarasova et al., 2016), Republic of Komi (Hermansson et al., 2006), and Murmansk Region (Konstantinova et al., 2014).

!+ CHAENOTHECOPSIS RUBESCENS Vain. – on aspen wood, XVI: 50, SYKO. – Distribution in neighboring territories: Murmansk Region (Urbanavichus & Urbanavichene, 2018), Tver Region (Notov et al., 2019), and Republic of Komi (Hermansson et al., 2006).

# ENDOCOCCLUS PROPINQUUS (Körb.) D. Hawksw. – on thalli of *Porpidia* cf. *cinereoatra*, *P. cinereoatra* and *P. crustulata*, VI: 39, LE 310120, LE 310122, LE 310121. – The ascospores are slightly larger than those reported in Triebel (1989), viz.  $(9.2\text{--}10.5\text{--}12.9\text{--}14.8) \times (5.2\text{--}5.9\text{--}7.5\text{--}9.3) \mu\text{m}$ ,  $l/b = (1.3\text{--}1.5\text{--}2.1\text{--}2.5)$  ( $n = 71$ , in water) vs.  $(7.5\text{--}8.5\text{--}12.5\text{--}13) \times 5\text{--}7\text{--}(7.5) \mu\text{m}$ . This is a common cosmopolitan species typically growing on *Porpidia* (Brackel, 2014; Triebel, 1989). Previously known in Arkhangelsk Region only from its Arctic part (Franz Josef Land and Novaya Zemlya; Lyngø, 1928; Zhurbenko & Santesson, 1996). Distribution in neighbouring territories: Leningrad region (Brenner, 1885), Murmansk Region (Zhurbenko, 2008), Republic of Karelia (Zhurbenko & Himelbrant, 2002), and Yamal-Nenets Autonomous Area (Zhurbenko, 2002).

# EPICLADONIA SANDSTEDEI (Zopf) D. Hawksw. – on *Cladonia coniocraea* (podetia, podetial squamules) on mossy boulder of hillside, VII: 40, LE 310128. – A common subcosmopolitan species confined to *Cladonia* (Brackel, 2014; Zhurbenko & Pino-Bodas, 2017). Previously known in Arkhangelsk Region only from its Arctic part (Nenets Autonomous Area; Zhurbenko & Pino-Bodas, 2017). Distribution in neighboring territories: Leningrad Region (Himelbrant et al., 2016), Murmansk Region (Zhurbenko & Himelbrant, 2002), and Republic of Komi (Zhurbenko, 2004).

!# HETEROCEPHALACRIA PHYSCIACEARUM (Diederich) Millanes & Wedin – on *Physcia aipolia* (thallus) growing on willow, VIII: 41, LE 310132. – A common cosmopolitan species (Diederich, 1996; Brackel, 2014). Distribution in neighboring territories: Leningrad Region (Stepanchikova et al., 2017), Republic of Karelia (Alstrup et al., 2005), and Republic of Komi (Alstrup, 2014).

! LECANACTIS ABIETINA (Ach.) Körb. – on bark of spruce, XX: 54, SYKO. – Distribution in neighboring territories: Republic of Komi (Hermans-

son et al., 1998), Republic of Karelia (Fadeeva et al., 2007), and Leningrad Region (Lebedeva, 2005).

! LEPTOGIUM RIVULARE (Ach.) Mont. (Fig. 2) – on bark of black alder, XVIII: 52, SYKO. RA. – This is a rare species in Russia. It is included in the global IUCN Red List of Threatened Species in the category Near Threatened (Randlane, 2015). Distribution in Russia: Murmansk Region (Halonen, 1996), Republic of Komi (Pystina et al., 1999, Pystina 2001; Degteva, 2019), Republic of Mari El (Bogdanov, 2015; Bogdanov & Urbanavichus, 2008), and Sverdlovsk Region (Paukov & Teptina, 2012, 2013).



**Fig. 2.** Fertile thallus of *Leptogium rivulare* (Ach.) Mont. on bark of black alder.

# LICHENODIPLIS LECANORAE (Vouaux) Dyko & D. Hawksw. – on *Mycoblastus sanguinarius* (thallus), IX: 42, LE 310131. – A common cosmopolitan species reported from various distantly related lichen host genera (Brackel, 2014). Previously known in Arkhangelsk Region only from its Arctic part (Nenets Autonomous Area) (Zhurbenko, 2009a). Distribution in neighboring territories: Leningrad Region (Stepanchikova et al., 2017).

# LICHENOSTICTA ALCICORNARIA (Linds.) D. Hawksw. – on *Cladonia coniocraea* (on the lower surface of basal squamules), X: 43, LE 310123. – A common subcosmopolitan species confined to *Cladonia* (Brackel, 2014; Zhurbenko & Pino-Bodas, 2017). Previously known in Arkhangelsk Region only from its Arctic part (Nenets Autonomous Area; Zhurbenko & Alstrup, 2004; Zhurbenko, 2008). Distribution in neighboring



territories: Leningrad Region (Himmelbrant et al., 2013), Murmansk Region (Zhurbenko & Alstrup, 2004), Republic of Karelia (Fadeeva et al., 2007), Yamal-Nenets Autonomous Area (Zhurbenko, 2008), and Republic of Komi (Zhurbenko, 2004).

!# LICHENOSTIGMA MAURERI Hafellner – on *Usnea dasypoga* (thallus), XI: 44, LE 310129. – Another common cosmopolitan species that is reported from various host lichen genera (Brackel, 2014). Distribution in neighboring territories: Leningrad Region (Himmelbrant et al., 2018), Republic of Karelia (Alstrup et al., 2005), Yamal-Nenets Autonomous Area (Zhurbenko, 2009b), and Republic of Komi (Zhurbenko, 2004).

! MELANELIXIA SUBAURIFERA (Nyl.) O. Blanco et al. – on smooth bark of alder, less often on bark of spruce, I: 9–10, 16, PZV. – A common boreal species reported from most regions of Russia (Urbanavichus, 2010). Distribution in neighboring territories: Murmansk Region (Urbanavichus et al., 2008), Leningrad Region (Kuznetsova et al., 2007a), Republic of Komi (Hermansson et al., 2006), and Republic of Karelia (Fadeeva et al., 2007).

! MELANOHALEA EXASPERATA (De Not.) O. Blanco et al. – on bark of aspen, I: 2, PZV. – A common boreal species reported from most regions of Russia (Urbanavichus, 2010). Distribution in neighboring territories: Murmansk Region (Urbanavichus et al., 2008), Leningrad Region (Kuznetsova et al., 2007a), Republic of Karelia (Fadeeva et al., 2007), and Republic of Komi (Pystina, 2003).

! MICAREA BOTRYOIDES (Nyl.) Coppins – on roots of fallen spruce trees, III: 23, 24, PZV. – Rare in Russia. Distribution in Russia: Leningrad Region (Stepanchikova et al., 2017), Republic of Karelia (Alstrup et al., 2005, Fadeeva et al., 2007), Kaliningrad Region (Dedkov et al., 2006; Czarnota, 2007), and Republic of Dagestan (Ismaïlov et al., 2019).

! MICAREA CONTEXTA Hedl. – on bark of dead bird cherry, I: 8; on stump of spruce, III: 25; on bark of standing dead spruce tree, III: 26, PZV. – Rare in Russia. Distribution in Russia: Republic of Karelia (Fadeeva et al., 2007), Republic of Komi (Hermansson et al., 2006), Leningrad Region (Himmelbrant et al., 2018), Kamchatka Territory, and Sakhalin Region (Konoreva et al., 2019a).

! MICAREA ELACHISTA (Körb.) Coppins & R. Sant. – on stand dead spruce tree, III: 27, PZV. – A com-

mon boreal species reported from most regions of Russia (Urbanavichus, 2010). Distribution in neighboring territories: Republic of Karelia (Fadeeva et al., 2007), Republic of Komi (Pystina, 2001; Hermansson et al., 2006), Leningrad Region (Himmelbrant et al., 2018), and Murmansk Region (Urbanavichus et al., 2008).

! MICAREA FALLAX Launis & Myllys – on bark of fallen spruce tree, I: 7; on stump of spruce, III: 34, PZV. – New to Russia. Distribution worldwide: Finland, Belarus, Czech Republic, Scotland, Sweden and Germany (Launis et al., 2019a). Morphologically, *Micarea fallax* is very similar to *M. prasina* s. str. and *M. laeta*; it differs from *M. prasina* s. str., which also produces micareic acid, mainly by crystals in hymenia (pol+), poorly developed thallus (if growing on wood) and bark preference. The secondary metabolites are important for the separation of *M. fallax* and *M. laeta*: *M. fallax* produces micareic acid, whereas *M. laeta* produces methoxymicareic acid (Launis et al., 2019a).

MICAREA GLOBULOSELLA (Nyl.) Coppins – on roots of fallen dead birch tree, III: 28, 34, PZV. – This species is widespread in the world, and sporadically found in Russia (Czarnota, 2007; Urbanavichus, 2010), but is often overlooked by researchers. Previously known in Arkhangelsk Region only from Onezhsky District (Tarasova et al., 2019). The specimens contain gyrophoric acid.

! MICAREA HEDLUNDII Coppins – on stump of spruce, III: 24, 34; on bark of willow, III: 34, PZV. – A common boreal species reported from most regions of Russia. Distribution in neighboring territories: Leningrad Region (Stepanchikova et al., 2011), Tver Region (Notov et al., 2016), and Republic of Komi (Pystina, 2001; Hermansson et al., 2006). The specimens contain no substances.

! MICAREA LAETA Launis & Myllys – on bark of dead bird cherry, I: 8, PZV. – New to the European part of Russia. Distribution worldwide: Russia – Sakhalin Region (Konoreva et al. 2019a), Finland, Sweden (Launis et al., 2019b), Austria, Germany, Great Britain and North America (Konoreva et al., 2019a). Morphologically, *Micarea laeta* is very similar to *M. byssacea*, *M. microareolata* and *M. fallax*; all these species have crystals (pol+) in hymenium and thallus. *Micarea laeta* never produces the Sedifolia-grey pigment in apothecia (while *M. byssacea*, on the

contrary, usually produces this pigment); contains methoxymicareic acid (whereas *M. fallax* contains micareic acid) (Launis et al., 2019b); ascospores 3–4 µm wide and goniocysts usually coalescing to form continuous crust or larger granules (while *M. microareolata* has narrower spores (2–3 µm wide) and an areolate thallus) (Launis et al., 2019b).

! MICAREA PRASINA Fr. s. str. – on stump of spruce, I: 5, 17, 21; III: 25, 31, 32, on bark of birch, III: 29, 30, PZV. – A common subcosmopolitan species, known in Russia from most regions as *Micareia prasina* s. lat. and needs to be revised. Distribution in neighboring territories (confirmed data about *M. prasina* s. str.): Leningrad Region (Konoreva & Chesnokov, 2017), Republic of Karelia (Fadeeva et al., 2007), Murmansk Region (Urbanavichus et al., 2008), and Republic of Komi (Hermansson et al., 2006). The specimens contain micareic acid. Crystals (pol+) are present in the epihymenium.

! MICAREA MICROAREOLATA Launis et al. – on bark of stand dead spruce tree, I: 8, PZV. – Rare in Russia and in the world. Distribution worldwide: Russia – Leningrad Region and Sakhalin Region (Konoreva et al., 2019a), Finland, Sweden (Launis et al., 2019b), Germany, Czech Republic and USA (Konoreva et al., 2019a). The examined material is not sufficient for chromatography, but the morphology of the sample is consistent with the description (Launis et al., 2019b): thallus effuse, pale olive green, thin, form convex to subglobose small areolae, apothecia adnate, ascospores 0–1-septate, 7.5–10 × 2–3 µm. Crystals (pol+) present in the hymenium and thallus.

MICAREA PELIOCARPA (Anzi) Coppins & R. Sant. – on roots of fallen spruce, III: 33, PZV. – A cosmopolitan species. Previously known only from Onezhsky District of Arkhangelsk Region (Tarasova et al., 2019).

! MICAREA PUSILLA Launis et al. – on stump of spruce, III: 34; on bark of dead bird cherry, I: 8, PZV. – New to the European part of Russia. Distribution worldwide: Russia – Republic of Dagestan, Finland, and Czech Republic (Launis et al., 2019a). *Micareia pusilla* is characterized by small, numerous and crowded whitish apothecia, olive green warted-granular or membranous thallus, and it contains methoxymicareic acid, while Sedifolia-grey pigment and crystals (pol-) are absent in the apothecia section and thallus (Launis et al., 2019a).

! MICAREA TOMENTOSA Czarnota & Coppins – on bark of fallen spruce tree, I: 7, PZV. – This is a rare species in Russia. Distribution in Russia: Moscow Region (Muchnik et al., 2019), Republic of Mordovia (Urbanavichene & Urbanavichus, 2017), Yakutia, Trans-Baikal Territory (Konoreva et al., 2018), and Kamchatka Territory (Konoreva et al., 2019a).

!+ MICROCALICIUM AHLNERI Tibell. – on bark on trunks and branches of spruce, I: 7, 12, 15–17, PZV; on lignum of standing dead pine, XIX: 53, SYKO. – A common boreal species reported from most regions of Russia (Urbanavichus, 2010). Distribution in neighboring territories: Leningrad Region (Stepanchikova et al., 2010, 2013), Republic of Karelia (Fadeeva et al., 2007), Republic of Komi (Hermansson et al., 2006), and Tver Region (Notov et al., 2011).

! NEPHROMA HELVETICUM Ach. (Fig. 3) – on bark of black alder, XXII: 58, SYKO. RA. – Distribution in neighboring territories: Republic of Karelia (Fadeeva et al., 2007), Republic of Komi (Degteva, 2019), Murmansk Region (Konstantinova et al., 2014), and Vologda Region (Konechnaya & Suslova, 2004).

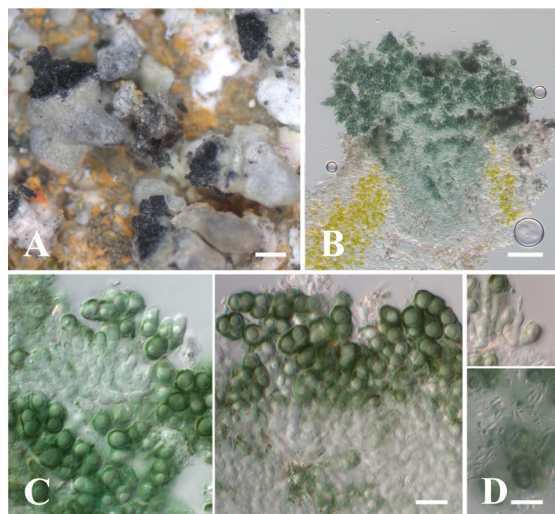


**Fig. 3.** Fertile thallus of *Nephroma helveticum* Ach. on bark of black alder.

! NEPHROMOPSIS LAURERI (Kremp.) Kurok. – on bark of spruce, birch, rarely on fir, XXIII: 60–66, SYKO, RA. – Distribution in neighboring territories: Republic of Karelia (Fadeeva et al., 2007), Republic of Komi (Degteva, 2019), and Kirov Region (Baranova et al., 2014).

#! NIGROPUNCTA RUGULOSA D. Hawksw. (Fig. 4) – on *Bellemerea* (thallus), XII: 45, LE 309452. – This

species was previously considered as a conidial lichen (Hawksworth & Poelt, 1986), but it is a lichenicolous fungus confined to *Bellemerea* (Diederich et al., 2018). We have observed in our material hyaline, bacilliform microconidia, not mentioned in the protologue (Fig. 4D; Hawksworth, 1981). The species is known from scattered finds in the Holarctic (Hawksworth & Poelt, 1986; Wirth, 1992; Hafellner, 1993; Alstrup & Elvebakk, 1996; Alstrup & Cole, 1998; Santesson et al., 2004; Hafellner & John, 2006; Alstrup et al., 2009; Etayo, 2010) and was also reported from New Zealand (Hafellner & Mayrhofer, 2007). It was previously known in Russia by an unpublished record from the Republic of Komi [Paga River, about 35 km SNE of Sivaja Maska, 66°22'00.01"N, 62°52'00.01"E, on *Bellemerea cinereorufescens* growing on rocks in tundra, 26.06.2007, Janolof Hermansson, 15610a, UPS: BOT: F-165224].



**Fig. 4.** *Nigropuncta rugulosa* D. Hawksw. (LE 309452). A – habitus of conidiomata on the thallus of *Bellemerea*; B – conidioma in cross section in water; C – conidiomata in cross section in K, note conidiophores, conidiogenous cells and conidia; D – microconidia in K (above) and water (below). Scales: A = 200  $\mu$ m; B = 50  $\mu$ m; C, D = 10  $\mu$ m.

*PELTIGERA ELISABETHAE* Gyeln. – on trunk base of birch, XXII: 59, SYKO, RA. – This species was formerly known in Arkhangelsk Region from its Arctic part (Franz Josef Land; Konoreva et al., 2019b), and from Pinezhsky District (Zeleznye

Vorota Reserve, Stanovy Log, 64°46'36.98"N, 43°05'22.5"E, on gypsum in sparse lichen-feathermoss pine forests on the karst ravine, 2008, leg. LP, det. E. Kuznetsova & D. Himelbrant, Herbarium of Pinezhsky Reserve; unpublished record).

! *PERTUSARIA COCCODES* (Ach.) Nyl. – on bark of spruce and aspen, I: 1, 17–19, PZV. – This species is an indicator of old-growth forests (Andersson et al., 2009) and is reported from most regions of Russia (Urbanavichus, 2010; Davydov & Printzen, 2012). Distribution in neighboring territories: Murmansk Region (Urbanavichus et al., 2008), Leningrad Region (Kuznetsova et al., 2007a), Republic of Karelia (Fadeeva et al., 2007), and Republic of Komi (Pystina, 2003).

!+ *PHAEOCALICIUM PRAECEDENS* (Nyl.) A. F. W. Schmidt – on bark of aspen, I: 2, PZV. – A common boreal species reported from most regions of Russia (Urbanavichus, 2010). Distribution in neighboring territories: Leningrad Region (Stepanchikova et al., 2010, 2013), and Republic of Komi (Hermansson et al., 1998).

! *PROTOTHELENELLA LEUCOTHELIA* (Nyl.) H. Mayrhofer & Poelt (Fig. 5) – on stones with thin soil layer, II: 22, PZV, RA. – A rare arctic-alpine species. Distribution in neighboring territories: Murmansk Region (Urbanavichus et al., 2008), and Republic of Komi (Hermansson et al., 2006).



**Fig. 5.** Fertile thallus of *Protothelenella leucothelia* (Nyl.) H. Mayrhofer & Poelt on stone with thin soil layer. Scale: 0.5 mm.



# PSEUDOPYRENIDIUM TARTARICOLA (Linds.) Nav.-Ros., Zhurb. & Cl. Roux – on *Ochrolechia mahuensis* (thallus) growing on spruce twigs, XII: 46, LE 310130. – This species was previously known from scattered finds throughout Holarctic, mainly from the Arctic and alpine habitats, growing on *Ochrolechia* (Alstrup & Hawksworth, 1990; Alstrup & Elvebakk, 1996; Santesson et al., 2004; Navarro-Rosinés et al., 2010; Brackel, 2014). It was formerly known in Arkhangelsk Region only from its Arctic part, viz. Franz Josef Land and Nenets Autonomous Area (Zhurbenko & Santesson, 1996; Navarro-Rosinés et al., 2010). Distribution in neighboring territories: Murmansk Region (Navarro-Rosinés et al., 2010), and Yamal-Nenets Autonomous Area (Zhurbenko & Zhdanov, 2013).

! PSOROGLAENA DICTYOSPORA (Orange) H. Harada – on dead wood, I: 20, PZV. – Distribution in neighboring territories: Tver Region (Notov et al., 2011), Leningrad Region (Himmelbrant et al., 2015), Pskov Region (Istomina et al., 2018), and Republic of Komi (Hermansson et al., 2006).

RAMALINA OBTUSATA (Arnold) Bitter – on standing dead fir, XVII: 51, SYKO, RA. – This species is known from most regions of Russia (Urbanavichus, 2010). Formerly known in Arkhangelsk Region only from Onezhsky District (Fadeeva, 2006).

!# SPIROGRAPHA FUSISPORELLA (Nyl.) Zahlbr. – on *Xylographa vitiligo* (thallus), XIII: 47, LE 310127. – This species was reported from both hemispheres growing on various distantly related lichen host genera (Brackel, 2014). It was previously known in Russia from Komi Republic, Murmansk Region, and Magadan Region (Zhurbenko, 2009a; Zhurbenko et al., 2012; Zhurbenko & Zheludeva, 2015).

STEINIA GEOPHANA (Nyl.) Stein – on bark of aspen and dead spruce, I: 2, IV: 36, PZV. – This species was formerly known in Arkhangelsk Region only from its Arctic part (Franz Josef Land; Konoreva et al., 2019b).

!+ STENOCYBE MAJOR Nyl. – on bark of fir, XX: 55, SYKO. – Widely distributed in the Holarctic (Titov, 2006). Distribution in neighboring territories: Republic of Komi (Pystina, 2003), and Kostroma Region (Urbanavichene & Urbanavichus, 2019).

!# TREMELLA HYPOGYMNIÆ Diederich & M. S. Christ. – on *Hypogymnia physodes* (thallus),

XIV: 48, LE 310133. – This species is widely distributed in the Holarctic growing on *Hypogymnia* (Diederich, 1996; Brackel, 2014). Distribution in neighboring territories: Leningrad Region (Himmelbrant et al., 2018), Murmansk Region (Zhurbenko & Zhdanov, 2013), Republic of Karelia (Alstrup et al., 2005), and Republic of Komi (Alstrup, 2014).

TUCKERMANNOPSIS CILIARIS (Ach.) Gyeln. – on branches of old birches, XV: 50, PZV, RA. – This species was formerly known in Arkhangelsk Region from Pinezhsky Reserve in Pinezhsky District (Puchnina et al., 2000). Distribution in neighboring territories: Murmansk Region (Urbanavichus et al., 2008), Leningrad Region (Kuznetsova et al., 2007a), Republic of Karelia (Fadeeva et al., 2007), and Republic of Komi (Pystina, 2003).

## DISCUSSION

In total, 31 species of lichens, 12 lichenicolous and 5 non-lichenized fungi are listed. Among these, 35 species are recorded for the first time for the Arkhangelsk Region and 7 species (*Endococcus propinquus*, *Epicladonia sandstedei*, *Lichenosticta alcorniaria*, *Lichenodiplis lecanorae*, *Peltigera elisabethae*, *Pseudopyrenidium tartaricola* and *Steinia geophana*) are new for its mainland area (i.e. the species have earlier been recorded only from arctic islands). *Micarea fallax* is new to Russia, *Micarea laeta* and *M. pusilla* are new to its European part. The second finding of *Nicropuncta rugulosa* in Russia is documented; microconidia are first observed in this species. Ten species are included in the new edition of the Red Data Book of Arkhangelsk Region (Anufriev et al., 2020): *Chaenotheca gracillima*, *C. sphaerocephala*, *C. phaeocephala*, *Leptogium rivulare*, *Nephroma helveticum*, *Nephromopsis laureri*, *Peltigera elisabethae*, *Protothelenella leucothelia*, *Ramalina obtusata* and *Tuckermannopsis ciliaris*. *Nephromopsis laureri* which is included also in the Red Data Book of Russian Federation (Bardunov & Novikov, 2008), and *Leptogium rivulare* which has been assessed as Near Threatened in the IUCN Red List (Randlane, 2015) are first documented for Arkhangelsk Region.

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**Appendix.** List of collecting sites in the Arkhangelsk Region (see also Fig. 1). Collectors and identifiers: AS – Angella Sonina, AV – Andrey Valekzhanin, ECh – Elena Churakova, LP – Liudmila Puchnina, MZh – Mikhail Zhurbenko, NB – Natalia Burova, NS – Natalia Semenova, TP – Tatiana Pystina, VA – Vera Androsova, VT – Viktoria Tarasova

No.	Locality	Coordinates	Altitude	Community	Collectors, identifiers	Collection date	
I	1	Pinezhsky District, upper reaches of the Njukhcha River	63°42'12.1"N, 46°19'13.8"E	179 m	bilberry feather-moss spruce forest	leg. & det. VT	20 June 2019
	2		63°41'42.9"N, 46°19'26.2"E	179 m	bilberry feather-moss spruce forest	leg. & det. VT	19 June 2019
	3		63°41'49.0"N, 46°19'43.6"E	159 m	paludified herb-rich spruce forest	leg. & det. VT	19 June 2019
	4		63°42'08.0"N, 46°13'24.8"E	183 m	bilberry feather-moss spruce forest	leg. & det. VT	20 June 2019
	5		63°42'10.6"N, 46°19'01.3"E	157 m	paludified herb-rich spruce forest	leg. VT, det. VT, LK & SCh	21 June 2019
	6		63°41'40.9"N, 46°16'50.3"E	180 m	paludified peat-moss spruce forest	leg. & det. VT	21 June 2019
	7		63°42'27.8"N, 46°19'56.4"E	139 m	paludified flood-plain herb-rich spruce forest	leg. VT, det. VT, LK & SCh	23 June 2019
	8		63°42'10.6"N, 46°20'51.4"E	140 m	paludified flood-plain herb-rich spruce forest	leg. VT, det. VT, LK & SCh	24 June 2019
	9		63°41'0.2"N, 46°21'4.3"E	128 m	paludified flood-plain herb-rich spruce forest	leg. & det. VT	24 June 2019
	10		63°42'27.8"N, 46°19'56.4"E	146 m	paludified flood-plain herb-rich spruce forest	leg. & det. VT	22 June 2019
	11		63°41'19.1"N, 46°16'42.9"E	167 m	paludified herb-rich spruce forest	leg. & det. VT	21 June 2019
	12		63°42'37.7"N, 46°18'46.0"E	142 m	paludified flood-plain herb-rich spruce forest	leg. & det. VT	22 June 2019
	13		63°43'06.4"N, 46°19'04.5"E	144 m	paludified peat-moss spruce forest	leg. & det. VT	23 June 2019
	14		63°40'43.8"N, 46°24'33.5"E	167 m	bilberry feather-moss spruce forest	leg. & det. VT	25 June 2019
	15		63°40'50.1"N, 46°22'17.2"E	160 m	bilberry feather-moss spruce forest	leg. & det. VT	25 June 2019

	16		63°43'23.9"N, 46°18'52.3"E	145 m	paludified flood- plain herb-rich spruce forest	leg. & det. VT	23 June 2019
	17		63°43'15.7"N, 46°18'42.5"E	148 m	paludified herb- rich spruce forest	leg. VT, det. VT, LK & Sch	22 June 2019
	18		63°41'50.8"N, 46°18'32.8"E	177 m	bilberry feather- moss spruce forest	leg. & det. VT	21 June 2019
	19		63°43'25.2"N, 46°18'3.4"E	166 m	bilberry feather- moss spruce forest	leg. & det. VT	23 June 2019
	20		63°42'27.7"N, 46°20'46"E	133 m	paludified flood- plain herb-rich spruce forest	leg. VT, det. Sch	24 June 2019
	21		63°42'34.2"N, 46°19'57.8"E	143 m	paludified flood- plain herb-rich spruce forest	leg. VT, det. LK & Sch	22 June 2019
II	22	Onezhsky District, Vetreny Poyas Ridge, Shapochka Mountain	63°36'46.3"N, 36°25'16.8"E	294 m	bilberry feather- moss spruce forest on rock	leg. AV, det. VT	8 June 2017
III	23	Onezhsky District, Vodloz- ersky National Park, Ileksa River basin	63°02'01.9"N, 36°56'42.7"E	172 m	floodplain herb- rich spruce forest	leg. VT, det. LK & Sch	9 June 2019
	24		63°01'57.2"N, 36°59'20.5"E	174 m	floodplain herb- rich spruce forest	leg. VA, det. LK & Sch	5 June 2019
	25		63°06'32.1"N, 36°48'33.4"E	175 m	paludified bilberry peatmoss spruce forest	leg. VA, VT, det. LK & Sch	9 June 2019
	26		63°11'04.6"N, 36°45'55.2"E	177 m	paludified herb- rich spruce forest	leg. VA, det. LK & Sch	10 June 2019
	27		62°49'27.8"N, 37°05'8.6"E	165 m	paludified bilberry peatmoss spruce forest	leg. VT, det. LK & Sch	7 June 2019
	28		63°10'26.4"N, 36°32'01.6"E	225 m	bilberry feather- moss spruce forest	leg. VT, det. LK & Sch	1 June 2019
	29		63°07'29.5"N, 36°47'55.2"E	175 m	bilberry feather- moss spruce forest	leg. VT, det. LK & Sch	10 June 2019
	30		63°11'27.2"N, 36°23'59.7"E	197 m	young (25 years after clear cutting) herb-rich birch forest	leg. VT, det. LK & Sch	1 June 2019
	31		63°01'57.2"N 37°00'11.6"E	173 m	floodplain herb- rich spruce forest	leg. VA, det. LK & Sch	5 June 2019
	32		63°15'26.9"N, 36°37'50.2"E	178 m	horsetail peatmoss spruce forest	leg. VT, det. LK & Sch	11 June 2019
	33		63°15'26.9"N, 36°37'50.2"E	176 m	paludified herb- rich spruce forest	leg. VA, det. LK & Sch	10 June 2019
	34		63°06'32.1"N, 36°48'33.4"E	175 m	paludified bilberry peatmoss spruce forest	leg. VA; det. LK & Sch	9 June 2019
IV	35	Onezhsky District, Vodloz- ersky National Park, north- ern border of the park, Vetreny Poyas Ridge, Volda Mountain	63°30'52"N, 36°37'29.7"E	285 m	bilberry feather- moss spruce forest	leg. & det. VT	11 June 2018
	36		63°30'52"N, 36°37'29.7"E	302 m	bilberry feather- moss spruce forest on rock	leg. & det. VT	11 June 2018



V	37	Onezhsky District, Vodlozersky National Park, western coast of Kalgachinskoe Lake	63°20'07"N, 36°40'06"E	178 m	herb-rich birch forest	leg. TP, det. MZh	3 July 2016
VI	38	Onezhsky District, Vodlozersky National Park, 4 km to the west of Kalgachinskoe Lake, Muroigora Mountain	63°20'27"N, 36°36'10"E	235 m	bilberry feather-moss spruce forest on rock	leg. ECh, det. MZh	4 July 2016
	39		63°34'24"N, 36°61'67"E	224 m	lichen-feather-moss spruce forest	leg. AS, det. MZh	13 June 2010, 9 June 2011
VII	40	Onezhsky District, Vodlozersky National Park, 1 km upstream from the mouth of the Olova River	63°16'15"N, 36°39'49"E	190 m	hillside	leg. ECh, det. MZh	6 July 2016
VIII	41	Onezhsky District, Vodlozersky National Park, near abandoned Kalgachikha village	63°19'46"N, 36°42'18"E	173 m	floodplain willow forest	leg. TP, det. MZh	1 July 2016
IX	42	Onezhsky District, Vodlozersky National Park, eastern bank of Verkhnyaya River, near Kerazh cabin	63°25'29"N, 36°37'38"E	187 m	floodplain herb-rich spruce forest	leg. ECh, det. MZh	28 June 2016
X	43	Onezhsky District, Vodlozersky National Park, 3.2 km NNW of abandoned Kalgachikha village, between Ulozero and Zadnee Lakes	63°21'06"N, 36°43'28"E	195 m	herbal-rich birch-aspen forest	leg. TP, det. MZh	2 July 2016
XI	44	Onezhsky District, Vodlozersky National Park, 3.5 km NNW of abandoned Kalgachikha village, southern shore of Zadnee Lake	63°21'17"N, 36°43'25"E	181 m	bilberry feather-moss birch-spruce-pine forest	leg. TP, det. MZh	2 July 2016
XII	45	Onezhsky District, Vetreny Poyas Ridge, Olovgora Mountain	63°24'40"N, 37°00'15"E	327 m	lichen-feather-moss spruce forest on rock	leg. AS, det. MZh	8 July 2013
	46		63°24'35"N, 37°00'11"E	320 m	lichen-feather-moss spruce forest on rock	leg. VT, det. MZh	6 June 2012
XIII	47	Onezhsky District, Vodlozersky National Park, Roin' Gora hill	63°17'09"N, 36°39'30"E	226 m	bilberry feather-moss pine forest on rock	leg. TP, det. MZh	6 July 2016
XIV	48	Onezhsky District, Vodlozersky National Park, foot of Bab'ya Gora hill	63°17'58"N, 36°40'55"E	226 m	herb-rich aspen forest	leg. TP, det. MZh	6 July 2016
XV	49	Plesetsky District, mouth of the Netoma River	62°13'28.4"N, 37°28'04.2"E	84 m	floodplain herb-rich spruce-birch forest	leg. VT, det. VT	16 July 2019
XVI	50	Krasnoborsky District, the right bank of the Lakhoma River, 3.24 km from the mouth of the Istok River	61°50'50.8"N, 46°00'14.2"E	56 m	linden-aspen forest with nearly dead ground layer vegetation	leg. & det. NS	2 August 2019
XVII	51	Krasnoborsky District, the left bank of the Lakhoma River, 2.8 km from the mouth of the Istok River	61°50'44.6"N, 45°59'58.4"E	53 m	fern-monkshood linden-birch-spruce forest	leg. & det. NS	2 August 2019

XVIII	52	Krasnoborsky District, floodplain of the Severnaya Dvina River, the right bank of the river, 12 km to the north-west from Dyabrino village	61°38'33.1"N, 45°46'7.6"E	70 m	paludified flood-plain herb-rich spruce-black alder forest	leg. & det. NS	6 August 2019
XIX	53	Krasnoborsky District, 14 km to the north from Bolshaya Sludka village, 400 m northeast of the forest road, near swamp	61°43'52.4"N, 46°00'45.0"E	77 m	paludified marsh tea peatmoss pine forest	leg. & det. NS	5 August 2019
XX	54	Krasnoborsky District, Krasnoborskoe forestry, Komarovskoe regional forest district, quarter 32	62°06'55.22"N, 47°22'30.6"E	175 m	old growth bilberry feathermoss spruce forest	leg. NB, det. TP	10 August 2017
	55		62°07'16.3"N, 47°22'47.3"E	168 m	old-growing bilberry feathermoss spruce forest	leg. NB, det. TP	11 August 2017
XXI	56	Onezhsky District, Onezhsky peninsula, Onezhskoe forestry, Nizhmozerskoe regional forest district, quarter 112	64°27'10.3"N, 37°12'31.6"E	84 m	bilberry feathermoss spruce forest	leg. & det. TP	25 June 2017
XXII	57	Verkhnetoyemsky District, near Lambas village, Vujskoe forestry, Gorkovskoe regional forest district, quarter 145, 167	64°27'10.3"N, 34°12'31.6"E	153 m	bilberry feathermoss spruce forest	leg. NB, det. TP	6 August 2018
	58		62°49'01.9"N, 45°32'01.7"E	173 m	bilberry feathermoss spruce forest, source of the stream	leg. NB, det. TP	5 August 2018
	59		62°49'0.3"N, 45°33'52.5"E	173 m	paludified flood-plain herb-rich spruce-black alder forest	leg. NB, det. TP	5 August 2018
XXIII	60	Leninsky District, near Shies railway station	61°53'12.6"N, 49°5'12.9"E	126 m	bilberry feathermoss pine forest	leg. & det. NS	8 June 2019
	61		61°53'14.5"N, 49°04'10.5"E	120 m	pine forests, along the edges of raised bogs	leg. & det. TP, NS	7 June 2019
	62		61°53'35.6"N, 49°05'28.8"E	51 m	sorrel peatmoss spruce forest	leg. & det. TP, NS	7 June 2019
	63		61°53'32.3"N, 49°06'04.0"E	17 m	old-growth paludified peatmoss spruce forest	leg. & det. TP, NS	8 June 2019
	64		61°52'56.6"N, 49°04'53.6"E	135 m	bilberry peatmoss spruce forest, along the edges of raised bogs	leg. & det. TP, NS	8 June 2019
	65		61°53'26.4"N, 49°03'30.0"E	54 m	shrub horsetail peatmoss spruce forest	leg. & det. TP, NS	9 June 2019
	66		61°53'20.1"N, 49°05'52.8"E =	54 m	sorrel peatmoss spruce forest	leg. & det. TP, NS	9 June 2019