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RESEARCH ARTICLE

Diversity and ecological drivers of lichens on Kunashir Island (Kuril Islands, Russian Far East)

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Abstract

The aim of this study is to examine the diversity of lichens in different communities of Kunashir Island and to identify factors influencing their distribution in the island. In total, we identified 172 species of lichens and allied fungi. *Ochrolechia lijiangensis* and *Pertusaria plittiana* are new to Russia. *Amandinea pelidna*, *Bacidina brandii* and *Lecanora caesiosora* are new for the Russian Far East. Thirteen species are reported for the first time for the Sakhalin Region. Six species are new for the Kuril Islands and 37 are new for Kunashir Island. Most of the identified lichens are corticolous species. The richest in the number of lichen species are *Abies sachalinensis*, *Betula ermanii*, *Quercus crispula*, *Picea ajanensis*, *Acer mayrii*, *Alnus hirsuta* and *Salix udensis* (25–40 species). It is shown that at the landscape level the only factor significant for the species composition of lichens is the community type, while at the substrate level, the coniferous or deciduous nature of the substrate and the acidity of the bark have an impact.

Keywords

Lichens, distribution, ecology, substrates, non-metric multidimensional scaling

Introduction

Kunashir is the southernmost island of the Greater Kuril Ridge and, at the same time, one of the largest of the Kuril Islands. The complex relief of the young volcanic island, its large area, and its proximity to the subtropical zone make it one of the richest in landscapes and biota. The territory of the island is covered with coniferous-broadleaf, coniferous and broadleaf forests, including more than 20 tree species, as well as a variety of woody vines and shrubs (Barkalov 2009). The following species predominate here: *Abies sachalinensis* (F. Schmidt) Mast., *Picea ajanensis* Fisch. ex Carrière, *P. glehnii* (F. Schmidt) Mast. (conifers), *Quercus crispula* Blume, *Acer mayrii* Schwer. (broad-leaved), *Betula ermanii* Cham., *Salix udensis* Trautv. et C. A. Mey., *Alnus hirsuta* (Spach) Turcz. ex Rupr. (small-leaved species, sometimes forming separate stands). The bark of trees, as well as associated shrubs and vines, is the most common substrate for colonization by lichens. Wood and fallen trees also play a significant role, especially from coniferous trees, which decompose more slowly.

The total forest area on Kunashir is about 61%. The remaining area is occupied by rocky, coastal, meadow, wetland and anthropogenic vegetation (Barkalov 2009). Kunashir's meadow and bog communities are largely inaccessible to lichens, which cannot compete with fast-growing grasses. Lichens are present to varying degrees in other communities. Epilithic lichen communities are common along the coasts of the island, on individual stones inland and on volcanic cones. Terricolous lichens inhabit open areas of coastal dunes and the vicinity of volcanoes. In addition, lichens have access to driftwood, which is not very abundant but does exist on the coasts. Lichens of anthropogenic communities are found on the wood of buildings and concrete, partially overlapping with driftwood lichens and epiliths, respectively. However, all these substrates are incomparably poorer in species composition than the forest communities prevailing on the island.

Such a high diversity of substrates, along with the humid island climate, are the reasons for the high diversity of lichens. For over a century Kunashir has attracted lichenologists from different countries, and its lichen biota is one of the most studied among the Kuril Islands. A significant contribution to the study of the species diversity of lichens here was made by such scientists as M. Satô, S. I. Tchabanenko, A. V. Dombrovskaya, L. I. Bredkina, T. Randlane, G. E. Insarov, A. V. Pchelkin, A. N. Titov (Satô 1936; Dombrovskaya 1987; Bredkina et al. 1992; Titov and Tibell 1993; Randlane et al. 1995; Insarov and Pchelkin 1998; Tchabanenko 2002). In recent years research on this matter is followed by such scientists as A. K. Ezhkin, I. A. Galanina and members of our research group (Ezhkin 2019; Galanina and Ezhkin 2019; Konoreva et al. 2020). At present, 373 species of lichens are known for Kunashir.

The aim of this study is to examine the diversity of lichens in different communities of Kunashir Island and to identify factors influencing their distribution in the island.

Materials and methods

Field and Laboratory study

Field investigations and specimen collections were made by first author since 15 August to 1 September 2024. Work was carried out mainly in the southern and central parts of the island, in the vicinity of Lake Peschanoye, the Golovnin and Mendeleev volcanoes, Cape Stolbchaty, the Stolbovskaya eco-trail and the settlement of Yuzhno-Kurilsk. Altogether 39 localities were investigated (Fig. 1): 37 standard sample plots (SP) (20 × 20 m in forest communities and 10 × 10 m in communities without trees), where the lichen diversity on each substrate was described as detailed as possible, and two additional sample plots, where only most interesting substrates and species were recorded. A complete census of all substrates was carried out on standard SP. Each SP took between 0.5 and 1.5 hours, depending on its complexity.

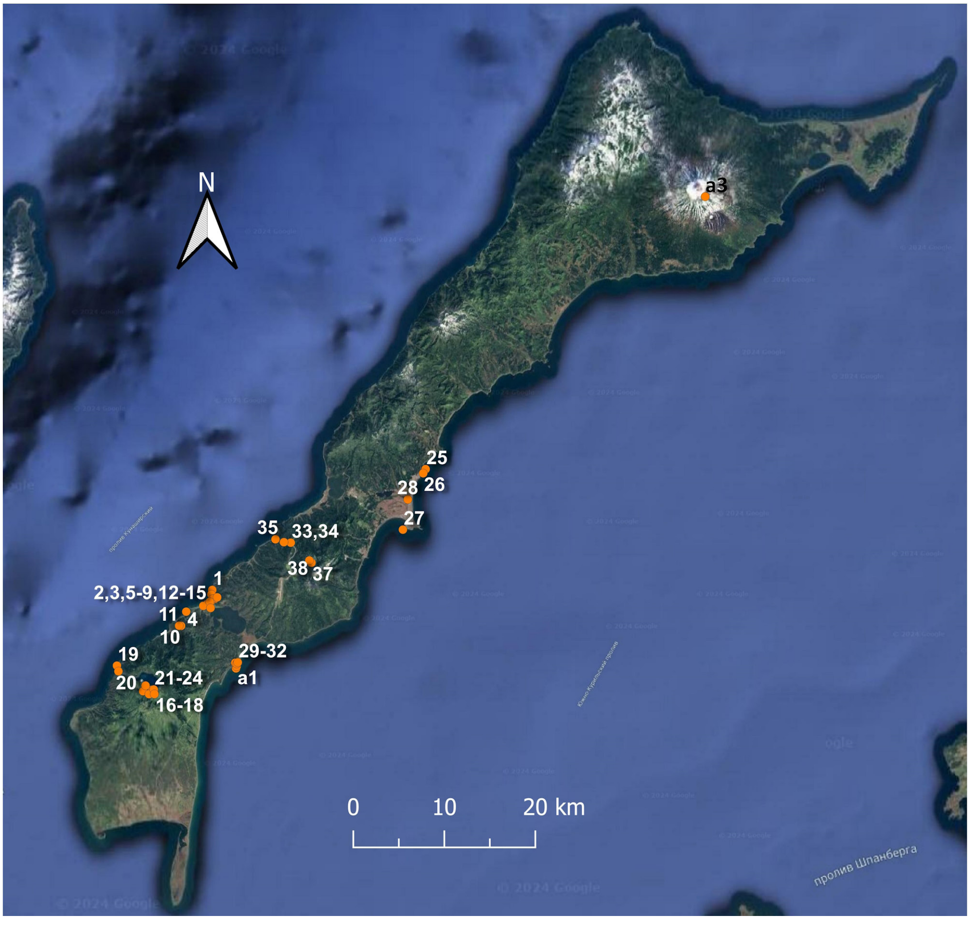

Figure 1. Location of sample plots on Kunashir Island.

During the work, coastal lichen communities on rocks (Fig. 2B) and driftwood (Fig. 2A), communities of dunes, streamside willows, coniferous (Fig. 3A, B), broad-leaved (Fig. 3C) and coniferous-broad-leaved (Fig. 3D) forests, epilithic volcanic communities (Fig. 2D) and communities of anthropogenic substrates (Fig. 2C) were studied. The lichens from the additional sample plot Ka3 were collected on Tyatya volcano by A. I. Tsidenkova, employee of the Kurilsky Reserve. For all sample plots coordinates, high under sea level and biotope were recorded. All lichen diversity on all substrates were recorded in the field and taken to laboratory for further study. List of localities is given below (Table 1). Geographical coordinates are given in the coordinate system WGS 1984.

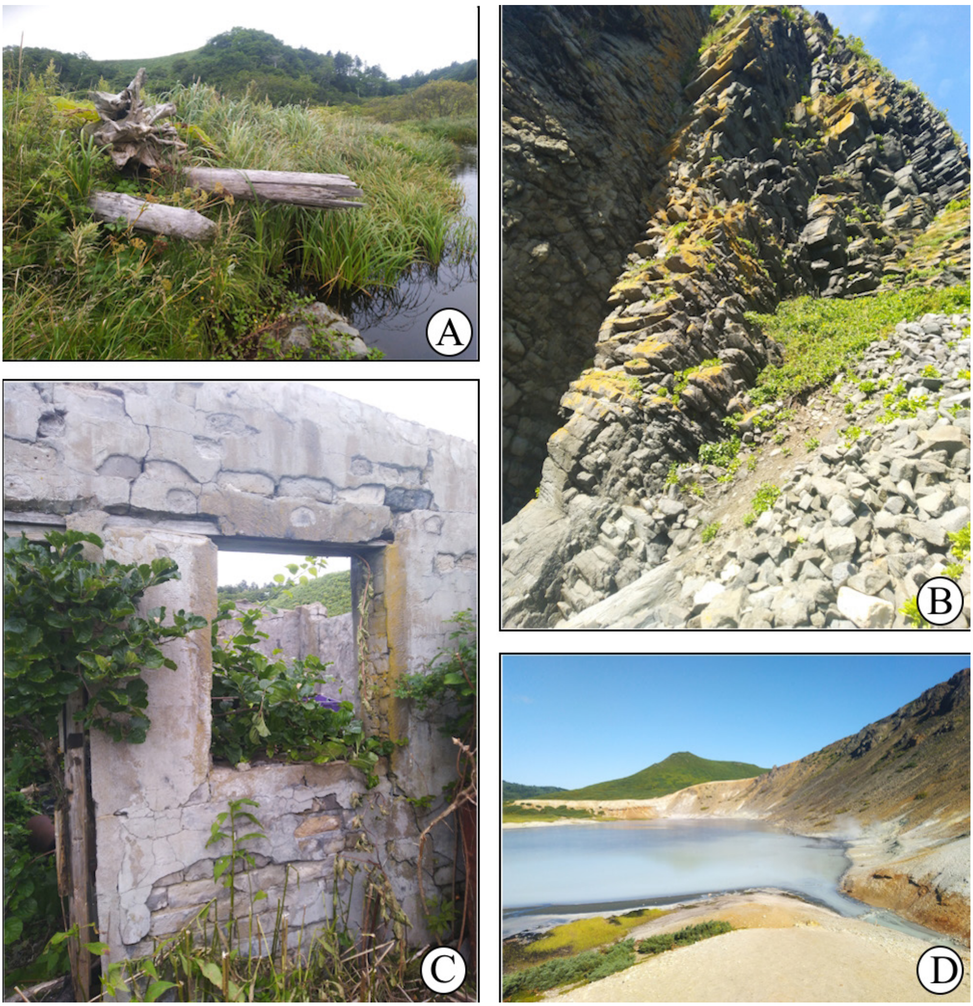

Figure 2. Different lichen communities on Kunashir Island: **A** – driftwood, **B** – seaside rocks, **C** – old concrete building, **D** – surroundings of Golovnin volcano.

Figure 3. Forest communities on Kunashir Island: **A** – *Picea ajanensis* forest, **B** – Glen spruce forest, **C** – Oak forest, **D** – coniferous-broadleaf forest with *Magnolia*.

Table 1. List of localities

№	Date	Location	N	E	Alt., m	Community
K1	16 Aug. 2024	Okhotsk Sea coast, Orlany stream	43°57'40"	145°35'30"	23	driftwood in the mouth of the stream
K2	16 Aug. 2024	Okhotsk Sea coast, surroundings of Danilovsky cordon	43°56'49"	145°35'05"	18	overgrown dunes
K3	16 Aug. 2024	Okhotsk Sea coast, surroundings of Peschanoye Lake	43°56'48"	145°35'14"	7	pumice stones among the dunes
K4	16 Aug. 2024	Okhotsk Sea coast, surroundings of Danilovsky cordon	43°56'23"	145°33'23"	12	seaside rocks
K5	16 Aug. 2024	Okhotsk Sea coast, surroundings of Danilovsky cordon	43°57'18"	145°35'34"	10	ruins of a concrete house
K6	16 Aug. 2024	Okhotsk Sea coast, surroundings of Danilovsky cordon	43°57'24"	145°35'26"	7	stones on the seashore

№	Date	Location	N	E	Alt., m	Community
K7	16 Aug. 2024	Okhotsk Sea coast, surroundings of Danilovsky cordon	43°57'09"	145°35'44"	26	coniferous-broadleaf forest
K8	16 Aug. 2024	Okhotsk Sea coast, surroundings of Peschanoye Lake	43°56'59"	145°35'24"	15	stones among the dunes
K9	17 Aug. 2024	Okhotsk Sea coast, surroundings of Danilovsky cordon	43°57'07"	145°35'31"	21	old wooden poles
K10	17 Aug. 2024	Okhotsk Sea coast, Cape Alekhina	43°55'33"	145°32'58"	91	fir-birch forest
K11	17 Aug. 2024	Okhotsk Sea coast, Cape Alekhina	43°55'33"	145°32'48"	78	alder-maple forest
K12	17 Aug. 2024	Okhotsk Sea coast, surroundings of Peschanoye Lake	43°56'43"	145°34'46"	9	rose hips on the dunes in the supralittoral
K13	17 Aug. 2024	Okhotsk Sea coast, surroundings of Peschanoye Lake	43°56'57"	145°35'18"	6	wood pole
K14	18 Aug. 2024	Okhotsk Sea coast, surroundings of Peschanoye Lake	43°56'36"	145°35'22"	11	driftwood log in the reeds
K15	18 Aug. 2024	Okhotsk Sea coast, surroundings of Danilovsky cordon	43°57'13"	145°35'54"	74	dead standing Ayan spruce trees on the edge of the forest
K16	20 Aug. 2024	Surroundings of Golovnin volcano, shore of lake Goryachiy	43°51'47"	145°30'37"	141	dwarf pine with crowberry on rubbles
K17	20 Aug. 2024	Surroundings of Golovnin volcano, Kal'dernyi cordon	43°51'32"	145°30'48"	166	wooden lagger on the roof of the cordon
K18	20 Aug. 2024	Surroundings of Golovnin volcano, road near lake Kipyashchee	43°51'41"	145°29'52"	147	clay roadside
K19	20 Aug. 2024	Okhotsk Sea coast, mouth of the river Ozernaya	43°53'12"	145°27'44"	26	seaside rocks
K20	20 Aug. 2024	Okhotsk Sea coast, slope to the river Ozernaya	43°52'52"	145°27'51"	127	broadleaf forest
K21	21 Aug. 2024	Surroundings of Golovnin volcano	43°51'31"	145°30'21"	168	Glen spruce forest with bamboo

№	Date	Location	N	E	Alt., m	Community
K22	21 Aug. 2024	Surroundings of Golovnin volcano, surroundings of the stream flowing into Lake Goryachee	43°51'47"	145°30'44"	141	birch-alder forb-grass forest
K23	21 Aug. 2024	Surroundings of Golovnin volcano, central dome of Golovnin volcano	43°52'01"	145°30'04"	262	dwarf pine with crowberry on rubbles
K24	21 Aug. 2024	Surroundings of Golovnin volcano, stream near the Kal'dernyi cordon	43°51'31"	145°30'47"	174	willow stand with bamboo and sacaline near the stream
K25	24 Aug. 2024	Pacific coast, surroundings of the Chortovy Gate	44°04'46"	145°52'54"	33	seaside rocks
K26	24 Aug. 2024	Pacific coast, Chortovy Gate	44°04'32"	145°52'42"	22	seaside rocks
K27	24 Aug. 2024	Pacific coast, Yuzhno-Kurilsk	44°01'13"	145°51'03"	11	abandoned lighthouse
K28	25 Aug. 2024	Pacific coast, bank of the Silver stream	44°02'59"	145°51'27"	-37	Glen spruce swamp forest
K29	28 Aug. 2024	Pacific coast, surroundings of Andreevsky cordon	43°53'02"	145°37'27"	13	stones on the seashore
K30	28 Aug. 2024	Pacific coast, surroundings of Andreevsky cordon	43°53'22"	145°37'23"	33	sparse oak-birch forest
K31	28 Aug. 2024	Pacific coast, surroundings of Andreevsky cordon	43°53'19"	145°37'31"	25	group of willows and alders
K32	28 Aug. 2024	Pacific coast, Belichii stream	43°53'23"	145°37'35"	10	driftwood in the mouth of the stream
K33	29 Aug. 2024	Pacific coast, Stolbovskaya trail	44°00'26"	145°41'54"	162	fir forest with birch
K34	29 Aug. 2024	Pacific coast, Stolbovskaya trail	44°00'28"	145°41'21"	91	sparse broadleaf forest with an old magnolia tree
K35	29 Aug. 2024	Pacific coast, Stolbovskaya trail	44°00'39"	145°40'39"	19	overgrown dunes
K36	29 Aug. 2024	Pacific coast, Cape Stolbchaty	44°01'15"	145°40'46"	14	seaside rocks

№	Date	Location	N	E	Alt., m	Community
K37	1 Sep. 2024	Mendeleev volcano, descent from the fumarole field	43˚59'24"	145˚43'25"	304	sides of a thermal stream
K38	1 Sep. 2024	Mendeleev volcano, trail to Mendeleev volcano	43˚59'16"	145˚43'36"	380	fir-birch forest with bamboo
Ka1	28 Aug. 2024	Pacific coast, surroundings of Andreevsky cordon	43˚53'9"	145˚37'30"	12	driftwood on the edge of supralittoral
Ka3	1 Oct. 2024	Tyatya volcano	44˚20'45"	146°15'43"	1414	rocks on the slope of volcano

The laboratory study was carried out according to the standard technique (The lichens… 2009; Stepanchikova and Gagarina 2014) in the laboratory of Lichenology and Bryology of the Komarov Botanical Institute RAS. The specimens were studied using a binocular stereoscopic microscope Olympus SZ51, transmitted light microscopes Mikmed-6 and Zeiss Axio Scope.A1, and a standard set of chemical reagents for color spot reactions. Lichens of the family Teloschistaceae were identified by I.V. Frolov.

Photographs of the species were taken with a stereoscopic microscope Motic SMZ 171-LED and Axio Scope.A1 with Axiocam 506 color camera.

Nomenclature of lichens and lichenicolous fungi mainly follows Westberg et al. (2021) and Spribille et al. (2023). Nomenclature of vascular plants follows https://www.plantarium.ru.

All collected and identified specimens are stored in the lichenological herbarium of Komarov Botanical Institute RAS (LE) and in the herbarium of the Botanical Garden-Institute of the Far Eastern Branch of the Russian Academy of Sciences (VBGI).

Chemical analyses

Some specimens were studied using high performance thin-layer chromatography (HPTLC) in solvent system C by first author (Orange et al. 2001). Some specimens of *Pertusaria* DC. and *Ochrolechia* A. Massal. genera were studied using high performance liquid chromatography (HPLC) on an Agilent 1200 instrumen by fourth author. For chromatographic separation, a Thermo Hypersil-Keystone C18, column (150×2.1 mm×5 µm) was used. The mobile phase consisted of (A) water: acetonitrile: formic acid (95 : 5 : 0.1 v/v), and (B) acetonitrile: water: formic acid (90 : 10 : 0.1 v/v). Analyses were performed at 30 °C with a flow rate of 0.3 ml/min in the gradient elution mode, and the percentage of B was programmed as follows: 5% (2 min) – 50% (5 min) – 70% (15 min) – 100% (25 min) – 100% (35 min). The volume of injected sample was 5 µL. The detection wavelength was 254 nm. Identification of the lichen substances was carried out using authentic reference standards of lichen substances from Komarov Botanical Institute collection.

Ecological analysis

For ecology analysis RStudio environment with packages "dplyr", "ggplot2" and "vegan" were used.

Non-metric multidimensional scaling (NMDS) was used to analyze sample plots and substrates depending on the similarity of species composition on them. The Jaccard index was used for distance measure and the species abundance data were not transformed. Using the function "envfit" factors, reliably affected on species composition were found ($P<0.02$). The analysis of the sample plots considered the influence of factors such as altitude, distance from the coast, community type, and the location of the sample plot on the coast of the Sea of Okhotsk or the Pacific Ocean. In the analysis of substrates (made only for species of arboreal substrates), the influence of such factors as substrate smoothness (with two categories: smooth or rough), its pH and coniferous or deciduous nature of the substrate was considered. With package "ggplot2" graphs were made, showing location of the sample plots and substrates in the space of the hypothetical axes NMDS1 and NMDS2. The closer the points representing sample plots (or substrate) are on the graph, the more similar the species composition of lichens on them is.

For occurrence analysis, 6 categories with a step of 20 % (Westhoff and van der Maarel 1973) were identified (see Table 1): R1 (rare, singular) – single record – the species was found once, R (rare) – recorded in 2–7 standard sample plots (no more than 20% of all SP), O (occasional) – 8–15 standard sample plots (20–40% SP), F (frequent) – 16–22 (40–60% SP), C (common) – 23–30 (60–80% SP), and VC (very common) – 31–38 (80–100% SP) [example of application: Rodionova et al. (2024)].

Results and discussion

As a result, 169 species of lichens, 2 species of lichenicolous fungi and 1 species of saprotrophic fungi were identified. Two of them are new for Russia, 3 are new for the Russian Far East, 13 are new for the Sakhalin Region, 6 are new for the Kuril Islands and 37 are new for Kunashir Island. An annotated list of lichens, lichenicolous and saprotrophic fungi is given below. For each lichen species, the substrate, sample areas, collector, herbarium number, frequency of occurrence, chemical substances, and nearest locations on the Kuril Ridge (or beyond) are provided.

The following designations are used before the names of species: "#" – lichenicolous fungi, "+" – non-lichenized fungi; "*" – new to Kunashir Island, "**" – new to Kuril Islands, "!" – new to Sakhalin Region, "!!" – new to Russian Far East, "!!!" – new to Russia, "R" – species listed in the Red Book of the Sakhalin Region (2019) and Russia (2024).

Collector names are abbreviated as follows: A. Zueva – AZ., A. Tsidenkova –AT.

Occurrence frequency is given in square brackets: R1 (rare, singular) – single record – the species was found once, R (rare) – recorded in 2–7 standard sample plots (no more than 20% of all SP), O (occasional) – 8–15 standard sample plots (20–40% SP).

Numbers of the sample plots corresponds to the locality numbers from Table 1 and Fig. 1.

List of species:

*#*Abrothallus parmeliarum* (Sommerf.) Arnold – K7, AZ, LE L-29593, [R1], on thallus of *Parmelia fertilis* on bark of *Abies sachalinensis*. Known from Urup Island (Zueva et al. 2025).

Acrocordia cavata (Ach.) R. C. Harris – K11, AZ, LE L-29534, L-29535, [R1], on bark of *Acer mayrii* and *Padus ssiori* F. Schmidt. Known from Kunashir Island (Ezhkin 2019).

A. gemmata (Ach.) A. Massal. – K11, AZ, LE L-29524, [R1], on bark of *Acer mayrii*. Known from Kunashir Island (Ezhkin 2019).

Alyxoria varia (Pers.) Ertz et Tehler – K7, AZ, [R1], on bark of *Picea ajanensis*. Known from Kunashir Island (Ezhkin 2019).

!!*Amandinea pelidna* (Ach.) Fryday et L. Arcadia (Fig. 4C, D) — K29, AZ, LE L-29525, [R1], on stones. This widespread species is restricted to coastal areas (The lichens… 2009). Characterized by the *Physconia*-type ascospores and thin, light gray to light brown thallus. Can be mistaken for *A. punctala* (Hoffm.) Coppins et Scheid. but the latter has *Buellia*-type spores (Foucard 2001; Mayrhofer and Moberg 2002). In Russia the nearest reliably locality is known from Franz Josef Land (Chesnokov and Konoreva 2023). The reports of the species far from the sea coast (Sedelnikova 2010, 2013) require revision.

**A. punctata* (Hoffm.) Coppins et Scheid. – K1, 8, 13, AZ, LE L-29526, VBGI, [R], on driftwood and stones. Known from Paramushir (Zueva et al. 2024a) and Shikotan (Chesnokov and Konoreva 2022) islands.

Anaptychia isidiata Tomin – K7, 11, 20, 30, AZ, LE L-29527, L-29528, L-29529, VBGI, [R], on bark of *Acer mayrii*, *Betula ermanii*, *Kalopanax septemlobus* (Thunb.) Koidz., *Populus tremula* L., *Quercus crispula*. Known from Kunashir Island (Tchabanenko 2002).

!*Arthonia didyma* Körb. – K10, AZ, LE L-29531, [R1], on bark of *Acer mayrii*. Known from Russian Far East (Urbanavichus 2010).

**Aspicilia cinerea* (L.) Körb. – Ka3, AT, [R1], on rocks. Known from Paramushir Island (Zueva et al. 2024a).

!*A. laevata* (Ach.) Arnold – K8, AZ, LE L-29532, [R1], on stones. Known from Chukotka Autonomous Area (Andreev et al. 1996).

Athallia holocarpa (Hoffm.) Arup et al. – K5, 8, AZ, [R], on stones and concrete. Known from Paramushir (Zueva et al. 2024a) and Shikotan (Chesnokov and Konoreva 2022) islands.

Bacidia kurilensis Gerasimova et al. – K33, AZ, LE L-29536, [R1], on bark of *Betula ermanii*. Known from Kunashir Island (Gerasimova et al. 2018).

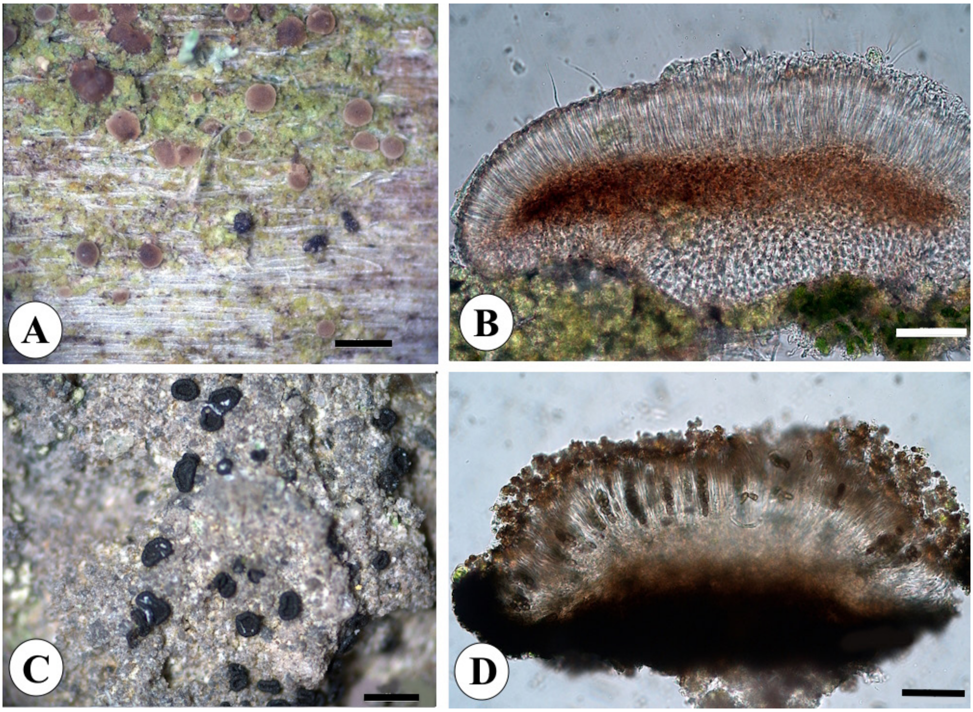

Figure 4. Species, new to Russia and Russian Far East. **A**, **B** – *Bacidina brandii* (appearance of lichen and apothecial section), **C**, **D** – *Amandinea peldina* (appearance of lichen and apothecial section).

!!*Bacidina brandii* (Coppins et van den Boom) M. Hauck et V. Wirth (Fig. 4A, B) – K32, AZ, LE L-29537, [R1], on driftwood. This is a rare and poorly known species in Russia. The nearest locality is known from the Leningrad Region (Stepanchikova et al. 2020). *Bacidina brandii* inhabits a variety of substrates and apparently prefers wet habitats (Coppins and van der Boom 2002; Ekman 2023). It is characterized by a granular-areolate thallus without soredia, pale red-brown to red-brown apothecia with a pale margin, a reddish-brown hypothecium, and acicular, slightly curved, 0-3-septate ascospores. Anatomically, *B. brandii* seems to be very close to *B. chlorotícula* (Nyl.) A. L. Sm and *B. saxenii* (Erichsen) M. Hauck et V. Wirth from which it differs by a dark hypothecium with Arnoldiana-brown pigment (Coppins and van der Boom 2002). *Bacidina brandii* can also be confused with *B. arnoldiana* (Körb.) V. Wirth et Vězda and *B. egenula* (Nyl.) Vězda, which also has Arnoldiana-brown pigment in hypothecium, but the last two species have sorediate thalli (Coppins and van der Boom 2002).

Bactrospora brodoi Egea et Torrente – K10, 15, AZ, LE L-29538, [R], on bark of *Abies sachalinensis*. Known from Kunashir Island (Ezhkin 2019).

**Biatora albohyalina* (Nyl.) Bagl. et Carestia – K11, 20, 22, 30, 31, 34, AZ, LE L-29539, L-29540, L-29541, L-29542, L-29543, L-29544, VBGI, [R], on bark of *Acer mayrii*, *Acer ukurunduense* Trautv. et C. A. Mey., *Alnus hirsuta*, *Fraxinus mandshurica* Rupr., *Magnolia obovata* Thunb., *Pinus pumila* (Pall.) Regel, *Quercus crispula*, *Salix udensis*. Known from Paramushir (Zueva et al. 2024a), Iturup (Chesnokov and Konoreva 2021) and Shikotan (Chesnokov and Konoreva 2022) islands.

B. efflorescens (Hedl.) Räsänen – K28, 30, 31, AZ, LE L-29546, L-29547, VBGI, [R], on bark of *Alnus hirsuta*, *Picea glehnii* and *Salix udensis*. Known from Kunashir Island (Tchabanenko 2002). Contains argopsin and unknown substances.

B. pacifica Printzen et al. – K20, 33, 34, AZ, LE L-29548, L-29549, L-29550, VBGI, [R], on bark of *Acer ukurunduense*, *Magnolia obovata*, *Sorbus commixta* Hedl., wood of *Abies sachalinensis*. Known from Kunashir Island (Chesnokov and Konoreva 2025).

B. pontica Printzen et Tønsberg – K10, 11, 20, 21, 28, 31, AZ, LE L-29551, L-29552, L-29553, L-29554, L-29555, VBGI, [R], on bark of *Alnus hirsuta*, *Picea glehnii*, *Populus tremula*, *Salix udensis*, *Sorbus commixta*, wood of *Abies sachalinensis*. Known from Kunashir Island (Chesnokov and Konoreva 2025). Contains thiophaninic acid.

Brigantiaea ferruginea (Müll. Arg.) Kashiw. et Kurok. – K7, 10, 11, 15, 33, 34, AZ, LE L-29556, L-29557, L-29558, L-29559, L-29560, VBGI, [R], on bark of *Acer mayrii*, *Betula ermanii*, *Magnolia obovata*, *Phellodendron amurense* Rupr., *Picea ajanensis*, *Taxus cuspidata* Siebold et Zucc., *Ulmus laciniata* (Herder) Mayr ex Schwapp. Known from Kunashir Island (Ezhkin 2019).

R*Bryocaulon pseudosatoanum* (Asahina) Kärnefelt – K15, AZ, LE L-29561, L-29562, VBGI, [R1], on bark and wood of dead *Abies sachalinensis* and *Picea ajanensis*. Known from Kunashir Island (Aristarkhova et al. 2021).

Buellia disciformis (Fr.) Mudd – K7, 11, 20, 24, 30, 31, 34, AZ, LE L-29563, L-29564, L-29565, L-29566, L-29567, L-29568, L-29569, L-29570, L-29571, L-29572, VBGI, [R], on bark of *Abies sachalinensis*, *Acer ukurunduense*, *Alnus hirsuta*, *Betula ermanii*, *Fraxinus mandshurica*, *Hydrangea arborescens* L., *Kalopanax septemlobus*, *Magnolia obovata*, *Salix udensis*, *Sorbus commixta*. Known from Kunashir Island (Tchabanenko 2002).

Calicium glaucellum Ach. – K15, AZ, LE L-29573, [R], on wood of dead *Picea ajanensis*. Known from Kunashir Island (Titov and Tibell 1991).

Caloplaca gordejevii (Tomin) Oxner – K7, 10, 11, 20, 24, 30, 31, 34, AZ, LE L-29576, L-29578, L-29579, L-29580, L-29581, L-29582, L-29583, L-29584, L-29585, VBGI, [O], on bark of *Acer mayrii*, *A. ukurunduense*, *Alnus hirsuta*, *Quercus crispula*, *Hydrangea arborescens*, *H. hydrangeoides* (Siebold et Zucc.) Bernd Schulz, *Kalopanax septemlobus*, *Magnolia obovata*, *Phellodendron amurense*, *Populus tremula*, *Salix udensis*, *Sambucus kamtschatica* E. L. Wolf, *Toxicodendron orientale* Greene. Known from Kunashir Island (Tchabanenko 1999).

***Candelariella aurella* (Hoffm.) Zahlbr. – K8, 13, AZ, LE L-29586, [R], on stones and wood of poles. Known from Paramushir Island (Zueva et al. 2024a).

!*C. efflorescens* R. C. Harris et W. R. Buck – K28, AZ, LE L-29587, VBGI, [R1], on bark of *Picea glehnii*. Known from Kamchatka Territory (Himelbant et al. 2019).

C. subdeflexa (Nyl.) Lettau – K20, AZ, LE L-29588, [R1], on bark of *Magnolia obovata*. Known from Kunashir Island (Chesnokov and Konoreva 2025).

Cetrelia braunsiana (Müll. Arg.) W. L. Culb. et C. F. Culb. – K15, AZ, LE L-29589, VBGI, [R1], on bark of dead *Picea ajanensis*. Known from Kunashir Island (Bredkina et al. 1992). Contains a-collatolic and alectoronic acids.

^{R}*Cetreliopsis asahinae* (M. Satô) Randlane et A. Thell – K7, AZ, LE L-29590, [R1], on bark of *Kalopanax septemlobus*. Known from Kunashir Island (Randlane et al. 1995).

Chaenotheca furfuracea (L.) Tibell – K7, 10, AZ, LE L-29591, L-29592, [R], on upside down roots of *Abies sachalinensis*. Known from Kunashir Island (Bredkina et al. 1992).

Cladonia arbuscula (Wallr.) Flot. – K2, AZ, LE L-29574, [R1], on overgrown dunes. Known from Kunashir Island (Urbanavichus and Urbanavichene 2004).

C. bellidiflora (Ach.) Schaer. – K23, AZ, LE L-29595, [R1], on soil and plant debris. Known from Kunashir Island (Tchabanenko 2002). Contains squamatic and usnic acid.

***C. carneola* (Fr.) Fr. – K2, AZ, LE L-29596, [R1], on overgrown dunes. Known from Paramushir Island (Zueva et al. 2024a).

C. cenotea (Ach.) Schaer. – K15, 21, AZ, LE L-29597, L-29598, VBGI, [R], on bases of the trunks of *Abies sachalinensis*, *Picea ajanensis* and *Picea glehnii*. Known from Kunashir Island (Tchabanenko 2002).

^{R}*C.* cf. *vulcani* Savicz – K16, 23, 37, AZ, [R], on bark of *Pinus pumila*, soil and stones. Known from Kunashir Island (Tchabanenko 2002).

C. coniocraea (Flörke) Spreng. – K7, 10, 12, 15, 20, 30, 33, 38, AZ, LE L-29599, L-29600, L-29601, L-29602, L-29603, L-29604, VBGI, [O], on bases of the trunks of *Abies sachalinensis*, *Betula ermanii*, *Magnolia obovata*, *Picea ajanensis*, *Quercus crispula* and *Rosa rugosa* Thunb. Known from Kunashir Island (Tchabanenko 2002).

***C. crispata* (Ach.) Flot. – K16, AZ, LE L-29605, [R1], on soil. Known from Paramushir (Tchabanenko 2002), Chirpoy (Glazkova et al. 2023) and Iturup (Tolpysheva and Varlygina 2021) islands.

C. farinacea (Vain.) A. Evans – K2, AZ, LE L-29606, [R1], on overgrown dunes. Known from Kunashir Island (Tchabanenko 2002).

C. floerkeana (Fr.) Flörke – K21, AZ, LE L-29607, VBGI, [R1], on bark of *Picea glehnii*. Known from Kunashir Island (Tchabanenko 2002).

C. furcata (Huds.) Schrad. – K2, AZ, LE L-29608, [R1], on overgrown dunes. Known from Kunashir Island (Tchabanenko 2002).

C. gracilis (L.) Willd. subsp. *turbinata* (Ach.) Ahti – K7, 15, 33, AZ, LE L-29609, L-29610, VBGI, [R], on bark of fallen trees of *Abies sachalinensis* and *Picea ajanensis*. Known from Kunashir Island (Tchabanenko 1999).

!*C. macrophyllodes* Nyl. – K7, AZ, LE L-29611, [R1], on wood of *Abies sachalinensis*. Known from Primorye Territory (Tchabanenko 2002).

**C. ochrochlora* Flörke – K10, AZ, LE L-29612, [R1], on wood of *Abies sachalinensis*. Known from Chirpoy Island (Glazkova et al. 2023).

C. pyxidata (L.) Hoffm. – K2, 12, AZ, LE L-29613, [R], on overgrown dunes. Known from Kunashir Island (Tchabanenko 2002).

C. rangiferina (L.) F. H. Wigg. – K2, 35, AZ, LE L-29614, VBGI, [R], on overgrown dunes. Known from Kunashir Island (Urbanavichus and Urbanavichene 2004).

C. rei Schaer. – K12, 14, AZ, LE L-29615, L-29616, [R], on overgrown dunes. Known from Kunashir Island (Tchabanenko 2002).

C. scabriuscula (Delise) Nyl. – K26, AZ, LE L-29617, [R1], on soil and plant debris. Known from Kunashir Island (Tchabanenko 1999).

C. squamosa Hoffm. – K7, AZ, [R1], on bark of *Abies sachalinensis*. Known from Kunashir Island (Ezhkin 2019).

Cliostomum corrugatum (Ach.:Fr.) Fr. – K7, 15, AZ, LE L-29624, VBGI, [R], on bark of *Picea ajanensis*. Known from Kunashir Island (Tchabanenko 2002).

C. griffithii (Sm.) Coppins – K15, AZ, LE L-29625, VBGI, [R1], on wood of dead *Picea ajanensis*. Known from Kunashir Island (Ezhkin, 2020).

Collema pulcellum Ach. – K20, AZ, LE L-29626, [R1], on bark of *Populus tremula*. Known from Kunashir Island (Ezhkin 2019).

Cresponea chloroconia (Tuck.) Egea et Torrente – K15, AZ, LE L-29628, [R1], on bark of *Picea ajanensis*. Known from Kunashir Island (Chesnokov and Konoreva 2025).

**Diarthonis spadicea* (Leight.) Frisch et al. – K12, 24, 30, AZ, LE L-29629, L-29630, VBGI, [R], on bark of *Quercus crispula*, *Rosa rugosa* and *Salix udensis*. Known from Iturup (Chesnokov and Konoreva 2021) and Shikotan (Chesnokov and Konoreva 2022) islands.

**Dibaeis baeomyces* (L.f.) Rambold et Hertel – K18, AZ, LE L-29631, [R1], on clay soil on the road. Known from Paramushir Island (Zueva et al. 2024a).

!*Dictyocatenulata alba* Finley et E.F. Morris – K30, AZ, LE L-29632, [R1], on bases of the trunks of *Betula ermanii*. Known from Primorye Territory (Diederich et al. 2008).

Flavoplaca flavocitrina (Nyl.) Arup et al. – K5, 27, AZ, [R], on concrete. Known from Kunashir Island (Chesnokov and Konoreva 2025).

***Fuscidea austera* (Nyl.) P. James – K4, 8, 26, 37, AZ, LE L-29633, L-29634, L-29635, [R], on rocks and stones. Known from Sakhalin (Konoreva et al. 2020). Contains divaricatic acid.

Graphis rikuzensis (Vain.) M. Nakan. – K7, 10, 11, 20, 30, 31, 33, 34, 38, AZ, LE L-29638, L-29639, L-29640, L-29641, L-29642, L-29643, L-29544, L-29645, L-29646, L-29647, L-29648, VBGI, [O], on bark of *Abies sachalinensis*, *Acer mayrii*, *Alnus hirsuta*, *Betula ermanii*, *Fraxinus mandshurica*, *Hydrangea hydrangeoides*, *Kalopanax septemlobus*, *Magnolia obovata*, *Padus ssiori*, *Phellodendron amurense*. Known from Kunashir Island (Ezhkin 2020). Contains no substanses.

G. tenella Ach. – K7, 15, 20, 22, 30, AZ, LE L-29649, L-29650, L-29651, L-29652, VBGI, [R], on bark of *Abies sachalinensis*, *Betula ermanii*, *Alnus hirsuta*, *Sorbus commixta*, *Quercus crispula*. Known from Kunashir Island (Tchabanenko 2002). Contains no substanses.

Heterodermia obscurata (Nyl.) Trevis. – K15, AZ, LE L-29653, [R1], on bark of *Picea ajanensis*. Known from Kunashir Island (Tchabanenko 2002).

!*Hydropunctaria maura* (Wahlenb.) C. Keller et al. – K25, AZ, LE L-29657, [R1], on rocks. Known from Kamchatka Territory (Himelbrant et al. 2021).

Hypogymnia fragillima (Hillmann) Rass. – K15, AZ, LE L-29658, [R1], on bark of *Picea ajanensis*. Known from Kunashir Island (Tchabanenko 1999).

H. metaphysodes (Asahina) Rass. – K28, AZ, LE L-29659, L-29660, VBGI, [R1], on bark of *Picea glehnii*. Known from Kunashir Island (Tchabanenko 2002).

H. physodes (L.) Nyl. – K8, 38, AZ, LE L-29661, VBGI, [R], on bark of *Abies sachalinensis*, soil. Known from Kunashir Island (Urbanavichus and Urbanavichene 2004). Contains atranorin, physodic, physodalic, 3-hydroxyphysodic acids, protocetraric acid (traces).

H. pseudophysodes (Asahina) Rass. – K28, 30, 33, AZ, LE L-29662, L-29663, L-29664, VBGI, [R], on bark of *Betula ermanii* and *Picea glehnii*, wood of *Abies sachalinensis*. Known from Kunashir Island (Tchabanenko 2002).

H. sachalinensis Tchabanenko et McCune – K28, AZ, LE L-29665, [R1], on bark of *Picea glehnii*. Known from Kunashir Island (Tchabanenko 2002).

H. tubulosa (Schaer.) Hav. – K15, AZ, LE L-29666, [R1], on bark of *Picea ajanensis*. Known from Kunashir Island (Tchabanenko 1999).

Julella sericea (A. Massal.) Coppins – K20, 34, AZ, LE L-29667, L-29668, [R], on bark of *Phellodendron amurense* and *Quercus crispula*. Known from Kunashir Island (Chesnokov and Konoreva 2025).

Lecanographa amylacea (Ehrh. ex Pers.) Egea et Torrente – K38, AZ, LE L-29669, [R1], on bark of *Abies sachalinensis*. Known from Kunashir Island (Ezhkin 2019).

Lecanora allophana Nyl. – K11, AZ, LE L-29670, [R1], on bark of *Hydrangea arborescens*. Known from Kunashir Island (Tchabanenko 2002).

!!*L. caesiosora* Poelt (Fig. 5B) – K19, 25, 26, 29, AZ, LE L-29671, L-29672, [R], inhabits rocks and stones. Specimens contain atranorin, chloratroanorin and roccelic acid (HPTLC). Thallus white with gray and yellow tinge (K+ yellow). Soralia are white (sometimes with blue or yellow tone) 1-2 mm large, rounded, slightly or strongly arched and very prominent against the thallus. Soredia are 20-25(-40) μm. Apothecia rare, 0.5-1.5(-2.5) mm, reddish-brown, often slightly pruinose. It differs from other sorediose species from the genus *Lecanora* by the color of the apothecia, the substrate, the shape and the arrangement of the soralia. Thus, *L. orae-frigidae* R. Sant. inhabits wood and has smaller and more frequently arranged yellowish soralia. The saxicolous *L. soralifera* (Suza) Räsänen has copper-grained flat soralia, black-green apothecia and an areolate-lobed edge of the thallus. *Lecanora chloroleprosa* (Vain.) H. Magn. has greenish soralia and different chemical compounds (usnic acid, zeorin) (Foucard 2001). The nearest locality is in the Leningrad Region (Stepanchikova et al. 2017).

**L. cinereofusca* H. Magn. – K7, 10, 33, 34, AZ, LE L-29673, L-29674, L-29675, L-29676, VBGI, [R], on bark of *Abies sachalinensis*, *Acer mayrii*, *Acer ukurunduense*, *Betula ermanii*, *Phellodendron amurense*. Known from Iturup (Konoreva et al. 2020) and Shikotan (Chesnokov and Konoreva 2022) islands.

!*L. epibryon* (Ach.) Ach. – K13, AZ, LE L-29677, [R1], on wood of poles. Known from Magadan Region (Kotlov 1995) and Kamchatka Territory (Himelbrant et al. 2021).

L. impudens Degel. – K10, AZ, LE L-29678, [R1], on bark of *Abies sachalinensis*. Known from Kunashir Island (Tchabanenko 2002).

L. pachyheila Hue – K7, 10, 11, 15, 34, AZ, LE L-29679, L-29680, L-29681, L-29682, VBGI, [R], on bark of *Abies sachalinensis*, *Acer mayrii*, *A. ukurunduense*, *Magnolia obovata*, *Padus ssiori*. Known from Kunashir Island (Tchabanenko 2002).

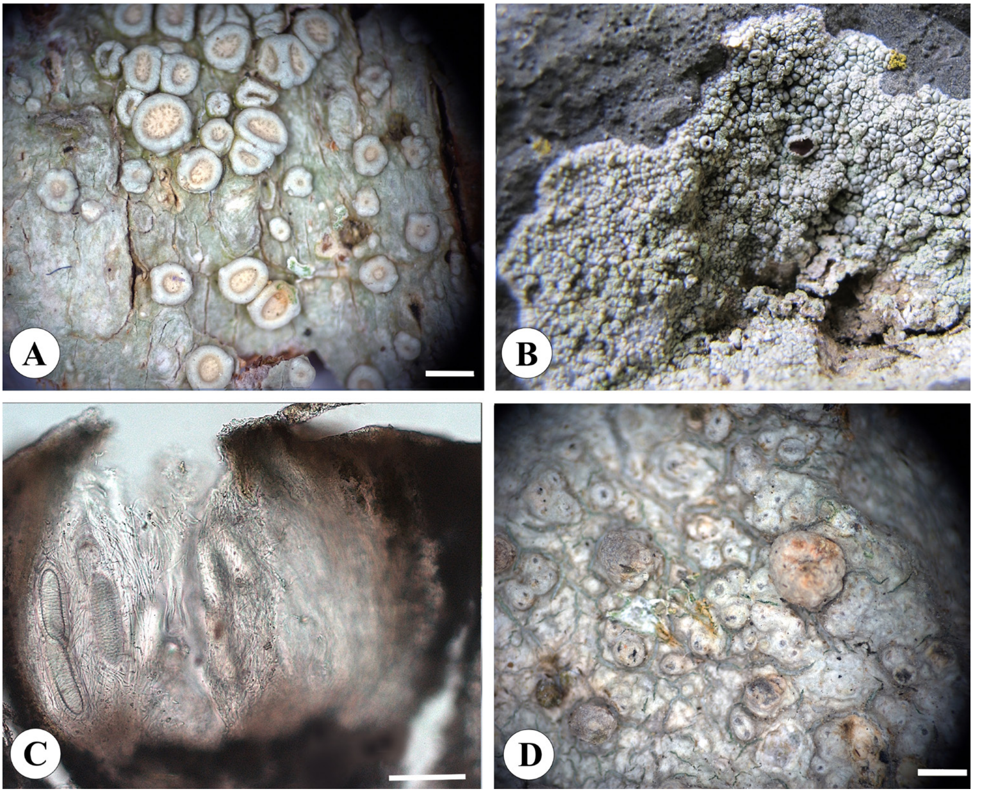

Figure 5. Species, new to Russia and (or) Russian Far East. **A** – *Ochrolechia lijiangensis*, **B** – *Lecanora caesiosora*, **C**, **D** – *Pertusaria plittiana* (appearance of lichen and apothecial section).

**L. polytropa* (Ehrh. ex Hoffm.) Rabenh. – Ka3, AT, [R1], on rocks. Known from Paramushir (Zueva et al. 2024a) and Shikotan (Chesnokov and Konoreva 2022) islands.

L. pulicaris (Pers.) Ach. – K7, 10, 11, 20, 24, 30, 31, AZ, LE L-29683, L-29684, L-29685, L-29686, L-29687, L-29688, L-29689, L-29690, L-29691, VBGI, [R], on bark of *Abies sachalinensis*, *Acer mayrii*, *Alnus hirsuta*, *Fraxinus mandshurica*, *Hydrangea arborescens*, *Kalopanax septemlobus*, *Magnolia obovata*, *Padus ssiori*, *Populus tremula*, *Quercus crispula*, *Salix udensis*, *Sorbus commixta*, *Toxicodendron orientale*. Known from Kunashir Island (Tchabanenko 2002).

**L. strobilina* (Spreng.) Kieff. – K12, 20, 22, 24, 30, 32, AZ, LE L-29692, L-29693, L-29694, VBGI, [R], on bark of *Alnus hirsuta*, *Betula ermanii*, *Magnolia obovata* and *Rosa rugosa*, wood of poles, wood and bark of driftwood. Known from Paramushir Island (Zueva et al. 2024a).

L. symmicta (Ach.) Ach. – K9, 12, 13, 15, 17, 22, 23, 24, 28, 30, AZ, LE L-29695, L-29696, L-29697, L-29698, L-29699, L-29700, VBGI, [O], on wood of buildings, wood of *Picea ajanensis*, bark of *Alnus hirsuta*, *Betula ermanii*, *Picea glehnii*, *Pinus pumila*, *Salix udensis*, *Rosa rugosa*. Known from Kunashir Island (Tchabanenko 2002).

!*Lecidea turgidula* Fr. – K17, AZ, LE L-29701, [R1], on wood of buildings. Known from Amur Region (Kuznetsova et al. 2022).

Lepra amara (Ach.) Hafellner – K7, 10, 11, 15, 33, 34, AZ, LE L-29702, L-29703, L-29704, L-29705, L-29706, L-29707, L-29708, L-29709, L-29710, VBGI, [R], on bark of *Abies sachalinensis*, *Acer mayrii*, *Betula ermanii*, *Hydrangea hydrangeoides*, *Picea ajanensis*, *Taxus cuspidata*. Known from Kunashir Island (Tchabanenko 2002). Contains picrolichenic and protocetraric acids.

!*L. borealis* (Erichsen) I. Schmitt et al. – K28, 30, AZ, LE L-29711, L-29712, [R], on bark of *Picea glehnii* and *Quercus crispula*. Known from Kamchatka Territory (Himelbrant et al. 2021). Contains protocetraric, fumarprotocetraric, succinioprotocetraric acids.

L. multipuncta (Turner) Hafellner – K30, 31, AZ, LE L-29713, L-29714, L-29715, VBGI, [R], on bark of *Alnus hirsuta* and *Betula ermanii*. Known from Kunashir Island (Tchabanenko 2002). Contains physodalic acid.

L. ophthalmiza (Nyl.) Hafellner – K7, 15, AZ, LE L-29716, L-29717, L-29718, L-29719, L-29720, L-29721, VBGI, [R], on bark of *Abies sachalinensis*, *Acer mayrii*, *Betula ermanii*, *Picea ajanensis*. Known from Kunashir Island (Chesnokov and Konoreva 2025). Contains fatty acids.

L. trachythallina (Erichs.) Lendermer et R.C. Harris – K7, 10, 30, 31, 33, 34, AZ, LE L-29722, L-29723, L-29724, L-29725, L-29726, L-29727, L-29728, L-29729, L-29730, L-29731, L-29732, L-29733, L-29734, L-29735, L-29736, L-29737, L-29738, VBGI, [R], on bark of *Abies sachalinensis*, *Acer mayrii*, *A. ukurunduense*, *Alnus hirsuta*, *Betula ermanii*, *Kalopanax septemlobus*, *Quercus crispula*, *Sorbus commixta*, *Salix udensis*. Known from Kunashir Island (Tchabanenko 2002). Contains thamnolic acid.

**Lepraria elobata* Tønsberg – K33, 34, AZ, LE L-29743, VBGI, [R], on bark of *Abies sachalinensis* and *Magnolia obovata*. Known from Sakhalin Island (Skirina et al. 2021). Contains atronarin, zeorin, stictic acid and unknown fatty acid.

!*L. finkii* (de Lesd.) R. C. Harris – K26, AZ, LE L-29746, [R1], on rocks. Known from Kamchatka Territory (Stepanchikova et al. 2023). Contains atronarin, zeorin, stictic acid and unknown fatty acid.

**L. jackii* Tønsberg s. l. – K7, 25, AZ, LE L-29744, VBGI, [R], on rocks, bark of *Taxus cuspidata*. Known from Paramushir Island (Zueva et al. 2024a). Contains atronarin, zeorin, jackinic/rangiformic and norjackinic/norrangiformic acids.

Leptogium cyanescens (Rabenh.) Körb. – K7, 30, AZ, LE L-29747, L-29748, VBGI, [R], on bark of *Acer mayrii* and *Quercus crispula*. Known from Kunashir Island (Tchabanenko 2002).

!+*Leptorhaphis epidermidis* (Ach.) Th. Fr. – K22, AZ, LE L-29749, [R1], on bark of *Betula ermanii*. Known from Primorye and Khabarovsk territories (Tchabanenko 2002).

[R]*Lobaria pulmonaria* (L.) Hoffm. – K30, AZ, [R1], on bark of *Quercus crispula*. Known from Kunashir Island (Ezhkin 2019).

L. sachalinensis Asah. – K7, AZ, LE L-29750, VBGI, [R1], on bark of *Acer mayrii* and *Kalopanax septemlobus*. Known from Kunashir Island (Tchabanenko 2002).

L. spathulata (Inumaru) Yoshim. – K30, AZ, LE L-29751, VBGI, [R1], on bark of *Quercus crispula*. Known from Kunashir Island (Tchabanenko 2002).

Lopadium disciforme (Flot.) Kullh. – K11, 15, 30, AZ, LE L-29752, L-29753, L-29754, [R], on bark of *Betula ermanii* and *Picea ajanensis*. Known from Kunashir Island (Tchabanenko 1999).

Megalospora atrorubicans (Nyl.) Zahlbr. subsp. *sendaiensis* (Ras.) Sipm. – K33, AZ, LE L-29755, [R1], on bark of *Abies sachalinensis*. Known from Kunashir Island (Tchabanenko 1999).

M. tuberculosa (Fée) Sipman – K7, 15, 33, 34, AZ, LE L-29756, L-29757, L-29758, L-29759, L-29760, VBGI, [R], on bark of *Abies sachalinensis*, *Betula ermanii*, *Magnolia obovata*, *Phellodendron amurense*, *Picea ajanensis*, *Taxus cuspidata*. Known from Kunashir Island (Tchabanenko 2002).

**Melanelia stygia* (L.) Essl. – Ka3, AT, [R1], on rocks. Known from Simushir (Satô 1936), Iturup (Ezhkin and Romanyuk 2024) and Shikotan (Chesnokov and Konoreva 2022) islands.

**Melanohalea exasperata* (De Not.) O. Blanco et al. – K22, 24, AZ, LE L-29761, L-29762, VBGI, [R], on bark of *Alnus hirsuta*, *Salix udensis*. Known from Paramushir (Zueva et al. 2024a) and Iturup (Konoreva et al. 2020) islands.

M. olivacea (L.) O. Blanco et al. – K12, 22, 24, 30, 31, AZ, LE L-29763, L-29764, L-29765, L-29766, L-29767, VBGI, [R], on bark of *Alnus hirsuta*, *Betula ermanii*, *Hydrangea arborescens*, *Rosa rugosa*, *Salix udensis*. Known from Kunashir Island (Tchabanenko 2002).

[R]*Menegazzia nipponica* K. H. Moon et al. – K7, 33, AZ, LE L-29768, [R], on bark of *Abies sachalinensis*. Known from Kunashir Island (Ezhkin 2019).

[R]_M. subsimilis_ (H. Magn.) R. Sant. – K7, 10, 14, 15, 33, 34, AZ, LE L-29769, L-29770, L-29771, L-29772, VBGI, [R], on bark of _Abies sachalinensis_, _Betula ermanii_, _Magnolia obovata_, _Picea ajanensis_, _Sorbus commixta_, rotten wood. Known from Kunashir Island (Ezhkin 2019).

*_Micarea elachista_ (Körb.) Coppins et R.Sant. – K15, AZ, LE L-29773, [R1], on wood of dead _Picea ajanensis_. Known from Shikotan Island (Ezhkin 2022).

M. peliocarpa (Anzi) Coppins et R. Sant. – K10, 33, AZ, LE L-29774, L-29775, [R], on wood of _Abies sachalinensis_. Known from Kunashir Island (Chesnokov and Konoreva 2025).

M. prasina Fr. s. str. – K21, AZ, LE L-29777, [R1], on fallen trees of _Abies sachalinensis_. Known from Kunashir Island (Tchabanenko 1999).

M. svetlanae Konoreva et Chesnokov – K7, 20, AZ, LE L-29778, L-29779, [R], on bark of _Picea ajanensis_ and _Quercus crispula_. Known from Kunashir Island (Konoreva et al. 2025).

Multiclavula mucida (Pers.) R. H. Petersen – K15, AZ, LE L-29780, [R1], on wood of _Picea ajanensis_. Known from Kunashir Island (Urbanavichus and Urbanavichene 2008).

**_Mycobilimbia carneoalbida_ (Müll.Arg.) S. Ekman et Printzen – K15, 20, 38, AZ, LE L-29781, VBGI, [R], on mosses bark of _Betula ermanii_, _Picea ajanensis_ and _Quercus crispula_. Known from Sakhalin Island (Kaganov and Ezhkin 2023).

*_Myelochroa entotheiochroa_ (Hue) Elix et Hale – K11, AZ, LE L-29782, [R1], on bark of _Acer mayrii_. Known from Shikotan Island (Chesnokov and Konoreva 2022).

M. subaurulenta (Nyl.) Elix et Hale – K7, 10, 34, AZ, LE L-29783, L-29784, VBGI, [R], on bark of _Acer mayrii_ and _Magnolia obovata_. Known from Kunashir Island (Tchabanenko 1999).

*_Myriolecis dispersa_ (Pers.) Śliwa et al. – K8, 13, AZ, LE L-29785, [R], on stones. Known from Paramushir (Zueva et al. 2024a) and Shikotan (Chesnokov and Konoreva 2022) islands.

*_M. straminea_ (Ach.) Śliwa et al. – K6, AZ, [R1], on stones. Known from Paramushir (Zueva et al. 2024a) and Broutona (Zueva et al. 2024b) islands.

Naevia punctiformis (Ach.) A.Massal. – K30, AZ, LE L-29786, [R1], on bark of _Betula ermanii_. Known from Kunashir Island (Chesnokov and Konoreva 2025).

Nephroma bellum (Spreng.) Tuck. – K24, AZ, LE L-29787, [R1], on bark of _Salix udensis_. Known from Kunashir Island (Tchabanenko 2002).

N. resupinatum (L.) Ach. – K24, AZ, LE L-29788, VBGI, [R1], on bark of _Salix udensis_. Known from Kunashir Island (Tchabanenko 2002).

Nephromopsis endocrocea Asahina – K10, AZ, LE L-29789, [R1], on bark of _Abies sachalinensis_. Known from Kunashir Island (Tchabanenko 2002).

[R]_N. laii_ (A. Thell et Randlane) Saag et A. Thell – K10, AZ, LE L-29790, [R1], on bark of _Abies sachalinensis_. Known from Kunashir Island (The Red… 2019).

*_Ochrolechia frigida_ (Sw.) Lynge – K4, AZ, LE L-29791, [R1], on rocks. Known from Paramushir (Zueva et al. 2024a) and Shikotan (Chesnokov and Konoreva 2022) islands. Contains gyrophoric acid.

!!!*O. lijiangensis* Q. Ren (Fig. 5A) – K7, 20, AZ, LE L-29792, L-29793, [R], on bark of *Abies sachalinensis* and *Populus tremula*. The specimens contain gyrophoric, lecanoric, lichesterinic and protolichesterinic acids (HPLC-MS). The species was described from China and was previously known from two provinces (Ren 2017). The species has white thallus and cream-colored apothecia with thick thallus margin and sometimes with warts on the margin. Epihymenium hyaline, 20–35 µm high; hymenium 230–250 µm high; hypothecium 50–60 µm high; asci 8-spored; ascospores simple, 50–60×20–30 µm. A morphologically similar species are *O. tartarea* (L.) A. Massal. and *O. trochophora* var. *trochophora* (Vain.) Oshio. However, these species absence of lichesterinic and protolichesterinic acids (Kukwa 2011). Additionally, *O. tartarea* contains three fatty acids called 'androgyna B unknowns' and usually grows on rocks (Kukwa 2011).

O. trochophora (Vain.) Oshio – K7, 11, 15, 20, 24, 34, AZ, LE L-29796, L-29797, L-29798, L-29799, VBGI, [R], on bark of *Abies sachalinensis*, *Acer ukurunduense*, *Alnus hirsuta*, *Betula ermanii*, *Magnolia obovata*, *Salix udensis*. Known from Kunashir Island (Tchabanenko 1999). Contains gyrophoric acid.

O. yasudae Vain. – K24, 28, 30, AZ, LE L-29800, L-29801, L-29802, L-29803, VBGI, [R], on bark of *Betula ermanii*, *Picea glehnii*, *Quercus crispula*, *Salix udensis*. Known from Kunashir Island (Tchabanenko 2002). Contains gyrophoric acid.

!*Orientophila corticola* B. G. Lee – K32, AZ, [R1], on driftwood. Known from Kamchatka Territory (Frolov et al. 2025).

Parmelia fertilis Müll. Arg. – K7, 10, 11, 12, 15, 17, 20, 24, 30, 31, 33, 38, AZ, LE L-29805, L-29806, L-29807, L-29808, L-29809, L-29810, L-29811, L-29812, L-29813, L-29814, L-29815, L-29816, L-29817, L-29818, L-29819, L-29820, VBGI, [O], on bark of *Abies sachalinensis*, *Acer mayrii*, *A. ukurunduense*, *Alnus hirsuta*, *Betula ermanii*, *Hydrangea hydrangeoides*, *H. arborescens*, *Kalopanax septemlobus*, *Magnolia obovata*, *Padus ssiori*, *Picea glehnii*, *Populus tremula*, *Quercus crispula*, *Salix udensis*, *Sorbus commixta*, *Taxus cuspidata*, *Rosa rugosa*, wood of buildings. Known from Kunashir Island (Tchabanenko 2002).

**P. praesquarrosa* Kurok. – K22, 24, AZ, LE L-29821, L-29822, L-29823, [R], on bark of *Alnus hirsuta*, *Betula ermanii*, *Salix udensis*. Known from Urup Island (Zueva et al. 2025).

P. saxatilis (L.) Ach. – K2, AZ, LE L-29824, [R1], on overgrown dunes. Known from Kunashir Island (Tchabanenko 2002).

P. squarrosa Hale – K7, 10, 12, 15, 20, 22, 28, 30, 33, 34, 38, AZ, LE L-29825, L-29826, L-29827, L-29828, L-29829, L-29830, L-29831, L-29832, L-29833, VBGI, [O], on bark of *Abies sachalinensis*, *Acer ukurunduense*, *Aralia* sp., *Betula ermanii*, *Magnolia obovata*, *Phellodendron amurense*, *Picea ajanensis*, *P. glehnii*, *Quercus crispula*, *Rosa rugosa*, *Sorbus commixta*. Known from Kunashir Island (Tchabanenko 2002).

Peltigera neckeri Hepp ex Müll. Arg. – K11, AZ, LE L-29834, [R1], on mosses fallen tree of *Abies sachalinensis*. Known from Kunashir Island (Tchabanenko 2002).

P. neopolydactyla (Gyeln.) Gyeln. – K2, AZ, LE L-29835, [R1], on overgrown dunes. Known from Shikotan Island (Chesnokov and Konoreva 2022).

**Peridiothelia fuliguncta* (Norman) D. Hawksw. – K24, 30, AZ, LE L-29836, L-29837, VBGI, [R], on bark of *Betula ermanii*, *Salix udensis*. Known from Sakhalin Island (Tchabanenko et al. 2018).

Pertusaria pertusa (Weigel) Tuck. – K11, 30, 33, 34, AZ, LE L-29838, L-29839, L-29840, VBGI, [R], on bark of *Quercus crispula*, *Acer mayrii*, *A. ukurunduense*, *Betula ermanii*. Known from Kunashir Island (Tchabanenko 2002). Contains stictic acid and 4,5-dichlorlichexanthone.

!!!*P. plittiana* Erichsen (Fig. 5C, D) – K4, 26, AZ, LE L-29842, L-29843, [R], on rocky cliffs. The specimens contain norstictic and connorstictic acids (HPTLC). The studied samples are characterized by white or light gray thallus, large verrucae (up to 1.5 mm in diameter) with 1 or several black ostioles, 2-spored asci, and large ascospores (150–200 × 60–90 μm) with a rough wall. *Pertusaria leucopsara* Krempelh. and *P. subobductans* Nyl. are morphologically similar species. *Pertusaria leucopsara* easily distinguished by smaller verrucae (0.1–0.3 mm in diameter) and small ascospores (20–40 × 11–15 μm) with a smooth wall (Zhao et al. 2004). *Pertusaria subobductans* is mainly corticolous and is distinguished by its narrower spores (according to Zhao et al. (2004)): 14–68 μm; according to Park et al. (2017): 40–55 μm) and contains of norstictic and perlatolic acids (Park et al. 2017). Currently, the species is known from China (Zhao et al. 2004), Japan (Paukov et al. 2021) and North America (Lendemer and Harris 2012).

!*P. subobductans* Nyl. – K11, 30, 31, AZ, LE L-29846, L-29847, L-29848, L-29849, L-29850, L-29851, L-29852, L-29853, L-29854, VBGI, [R], on bark of *Acer mayrii*, *Alnus hirsuta*, *Betula ermanii*, *Hydrangea arborescens*, *Padus ssiori*, *Quercus crispula*, *Salix udensis*. Known from Primorye Territory (Rodnikova et al. 2019), Khabarovsk Territory (Skirina 2012). Contains norstictic acid.

**Phaeocalicium compressulum* (Szatala) A. F. W. Schmidt – K24, AZ, LE L-29856, [R1], on twigs of *Alnus hirsuta*. Known from Paramushir (Zueva et al. 2024a), Iturup (Titov 2006) and Shikotan (Chesnokov and Konoreva 2022) islands.

**Phaeophyscia hirtella* Essl. – K28, AZ, LE L-29857, [R1], on bark of *Picea glehnii*. Known from Shikotan Island (Chesnokov and Konoreva 2022).

P. rubropulchra (Degel.) Essl. – K11, 24, 28, 30, 31, AZ, LE L-29858, L-29859, L-29860, L-29861, VBGI, [R], on bark of *Picea glehnii*, *Quercus crispula*, *Salix udensis*, *Sambucus kamtschatica*, *Toxicodendron orientale*. Known from Kunashir Island (Tchabanenko 2002).

Physcia aipolia (Ehrh. ex Humb.) Fürnr. – K22, 24, AZ, LE L-29862, L-29863, VBGI, [R], on bark of *Betula ermanii*, *Hydrangea arborescens*, *Salix udensis*. Known from Kunashir Island (Ezhkin 2020).

P. alnophila (Vain.) Loht. et al. – K24, AZ, LE L-29864, [R1], on bark of *Hydrangea arborescens* and *Salix udensis*. Known from Kunashir Island (Ezhkin 2019).

**Placynthiella icmalea* (Ach.) Coppins et P. James – K15, AZ, LE L-29865, [R1], on bark of dead *Picea ajanensis*. Known from Shikotan Island (Chesnokov and Konoreva 2022).

Platismatia interrupta W. L. Culb. et C. F. Culb. – K7, 10, 15, 28, 30, 33, 38, AZ, LE L-29866, L-29867, L-29868, L-29869, L-29870, VBGI, [R], on bark of *Betula ermanii*, *Picea glehnii*, *Quercus crispula*, *Sorbus commixta*, bark of and wood of *Abies sachalinensis*. Known from Kunashir Island (Tchabanenko 2002).

Polycauliona candelaria (L.) Frödén et al. – K37, AZ, [R1], on rocks. Known from Paramushir (Zueva et al. 2024a), Broutona (Zueva et al. 2024b), Iturup (Chesnokov and Konoreva 2021) and Shikotan (Chesnokov and Konoreva 2022) islands.

P. verruculifera (Vain.) Arup et al. – K6, 25, AZ, LE L-29872, [R], on rocks and stones. Known from Paramushir (Zueva et al. 2024a), Broutona (Zueva et al. 2024b) and Iturup (Chesnokov and Konoreva 2021) islands.

Porpidia crustulata (Ach.) Hertel et Knoph – K3, 8, 16, 18, 29, AZ, LE L-29873, L-29874, L-29875, L-29876, VBGI, [R], on rocks and stones (including pumice stones). Known from Paramushir (Zueva et al. 2024a) and Shikotan (Chesnokov and Konoreva 2022) islands.

Protoparmeliopsis muralis (Schreb.) M. Choisy – K8, AZ, LE L-29877, [R1], on stones. Known from Paramushir Island (Zueva et al. 2024a).

Pseudephebe pubescens (L.) M. Choisy – Ka3, AT, [R1], on rocks. Known from Paramushir, Atlasova (Asahina 1934) and Iturup (Ezhkin and Romanyuk 2024) islands.

**Pseudosagedia aenea* (Wallr.) Hafellner et Kalb. – K11, 31, AZ, LE L-29878, VBGI, [R], on bark of *Alnus hirsuta* and *Padus ssiori*. Known from Sakhalin Island (Galanina 2013).

Ramalina almquistii Vain. – K8, AZ, LE L-29879, [R1], on stones. Known from Kunashir Island (Tchabanenko 2002).

R. dilacerata (Hoffm.) Hoffm. – K7, 11, 12, 15, 24, 30, 31, 33, AZ, LE L-29880, L-29881, L-29882, L-29883, L-29884, L-29885, VBGI, [R], on bark of *Abies sachalinensis*, *Acer mayrii*, *Picea ajanensis*, *Quercus crispula*, *Rosa rugosa*, *Salix udensis*. Known from Kunashir Island (Tchabanenko 2002). Contains divaricatic and sekikaik acids.

R. pertusa Kashiw. – K11, 31, AZ, LE L-29886, L-29887, VBGI, [R], on bark of *Acer mayrii*, *Alnus hirsuta*, *Hydrangea hydrangeoides*, *Padus ssiori*. Known from Kunashir Island (Joneson et al. 2004). Contains evernic acid.

R. roesleri (Hochst. ex Schaer.) Hue – K7, 10, 11, 12, 15, 22, 28, 30, 31, 32, 33, AZ, LE L-29888, L-29889, L-29890, L-29891, L-29892, L-29893, L-29894, L-29895, L-29896, L-29897, L-29898, VBGI, [O], on bark of *Abies sachalinensis*, *Acer mayrii*, *Alnus hirsuta*, *Aralia* sp., *Betula ermanii*, *Hydrangea arborescens*, *Kalopanax septemlobus*, *Picea ajanensis*, *P. glehnii*, *Populus tremula*, *Quercus crispula*, *Rosa rugosa*, *Salix udensis*, *Sambucus kamtschatica*, wood and bark of driftwood. Known from Kunashir Island (Tchabanenko 2002).

R. scoparia Vain. – K4, AZ, LE L-29899, L-29900, [R1], on rocky cliffs. Known from Paramushir, Onekotan, Makanrushi, Shiashkotan, Raikoke, Simushir, Ketoy, Urup, Iturup, Shikotan (Joneson et al. 2004) islands.

Ricasolia quercizans (Michx.) Stizenb. – K7, 34, AZ, LE L-29901, L-29902, [R], on bark of *Kalopanax septemlobus* and *Magnolia obovata*. Known from Kunashir Island (Tchabanenko 2002).

**Rinodina excrescens* Vain. – K30, AZ, LE L-29905, VBGI, [R1], on bark of *Alnus hirsuta*. Known from Iturup (Chesnokov and Konoreva 2021) and Shikotan (Chesnokov and Konoreva 2022) islands.

R. freyi H. Magn. – K12, 22, 24, 32, AZ, LE L-29906, L-29907, [R], on bark of *Betula ermanii*, *Rosa rugosa*, *Salix udensis*, driftwood. Known from Kunashir Island (Galanina and Ezhkin 2019).

R. gennarii Bagl. – K27, 29, 37, AZ, LE L-29908, L-29909, VBGI, [R], on stones, rocks, concrete. Known from Kunashir Island (Galanina and Ezhkin 2019).

***R. septentrionalis* Malme – K24, AZ, LE L-29910, [R1], on bark of *Salix udensis*. Known from Sakhalin Island (Galanina 2013; Ezhkin 2020; Sheard et al. 2017; Galanina et al. 2021).

R. subalbida (Nyl.) Vain. – K15, 30, AZ, LE L-29911, L-29912, VBGI, [R], on bark of *Picea ajanensis* and *Quercus crispula*. Known from Kunashir Island (Galanina and Ezhkin 2019).

R. subparieta (Nyl.) Zahlbr. – K1, 11, 28, 30, AZ, LE L-29913, L-29914, VBGI, [R], on bark of *Alnus hirsuta*, *Picea ajanensis* and *P. glehnii*. Known from Kunashir Island (Galanina and Ezhkin 2019).

R. xanthophaea (Nyl.) Zahlbr. – K30, AZ, LE L-29915, [R1], on bark of *Quercus crispula*. Known from Kunashir Island (Galanina and Ezhkin 2019).

Ropalospora phaeoplaca (Zahlbr.) S. Ekman – K7, 15, 20, 22, 38, AZ, LE L-29916, L-29917, L-29918, VBGI, [R], on bark of *Abies sachalinensis*, *Betula ermanii*, *Picea ajanensis*, *Quercus crispula*, *Taxus cuspidata*. Known from Kunashir Island (Urbanavichus and Urbanavichene 2004).

Rusavskia elegans (Link) S. Y. Kondr. et Kärnefelt – K27, AZ, LE L-29919, [R1], on concrete. Known from Kunashir Island (Tchabanenko 2002).

Scoliciosporum umbrinum (Ach.) Arnold – K8, AZ, LE L-29920, L-29921, VBGI, [R1], on stones. Known from Kunashir Island (Ezhkin 2019).

#*Sphinctrina turbinata* (Pers.) De Not. – K30, AZ, LE L-29922, L-29923, [R1], on thallus of *Pertusaria pertusa* on bark of *Acer ukurunduense*, thalli of *Pertusaria* sp. and *Varicellaria velata* on bark of *Quercus crispula*. Known from Kunashir Island (Tchabanenko 2002).

**Strigula affinis* (A. Massal.) R. C. Harris – K30, AZ, LE L-29924, [R1], on bark of *Quercus crispula*. Known from Shikotan Island (Chesnokov and Konoreva 2022).

Tephromela atra (Huds.) Hafellner – K7, 11, 20, 24, 28, 31, 34, AZ, LE L-29926, L-29927, L-29928, L-29929, L-29930, VBGI, [R], on bark of *Acer ukurunduense*, *Alnus hirsuta*, *Padus ssiori*, *Picea glehnii*, *Quercus crispula*, *Salix udensis*, *Sorbus commixta*. Known from Kunashir Island (Tchabanenko 2002).

Tetramelas triphragmioides (Anzi) A. Nordin et Tibell – K7, 15, AZ, LE L-29931, L-29932, VBGI, [R], on bark of *Abies sachalinensis* and *Picea ajanensis*. Known from Kunashir Island (Tchabanenko 2002).

Thelotrema lepadinum (Ach.) Ach. – K15, 30, 33, 34, AZ, LE L-29933, L-29934, L-29935, VBGI, [R], on bark of *Abies sachalinensis*, *Betula ermanii*, *Magnolia obovata*, *Phellodendron amurense*, *Picea ajanensis* and *Quercus crispula*. Known from Kunashir Island (Tchabanenko 1999).

**Umbilicaria hyperborea* (Ach.) Hoffm. – Ka3, AT, [R1], on rocks. Known from Paramushir Island (Ezhkin and Davydov 2021).

[R]*Usnea diffracta* Vain. – K7, 10, 15, 28, 30, 33, 34, AZ, LE L-29937, L-29938, L-29939, L-29940, L-29941, L-29942, L-29943, L-29944, VBGI, [R], on bark of and wood of *Abies sachalinensis*, bark of *Acer ukurunduense*, *Betula ermanii*, *Picea ajanensis*, *P. glehnii*, *Quercus crispula*. Known from Kunashir Island (Tchabanenko 2002).

U. longissima Ach. – K7, 10, 15, AZ, LE L-29945, L-29946, VBGI, [R], on bark of dead *Abies sachalinensis* and *Picea ajanensis*. Known from Kunashir Island (Gagarina and Ezhkin 2020).

U. pangiana Stirt. – K7, 30, AZ, LE L-29947, L-29948, VBGI, [R], on bark of *Betula ermanii* and *Kalopanax septemlobus*. Known from Kunashir Island (Gagarina and Ezhkin 2020).

Varicellaria velata (Turner) I. Schmitt et Lumbsch – K7, 11, 30, AZ, LE L-29949, L-29950, VBGI, [R], on bark of *Acer mayrii*, *Padus ssiori*, *Quercus crispula*. Known from Kunashir Island (Tchabanenko 2002). Contains lecanoric acid.

**Xanthoparmelia stenophylla* (Ach.) Ahti et D. Hawksw. – K8, AZ, LE L-29951, [R1], on stones. Known from Shikotan Island (Chesnokov and Konoreva 2022). Contains usnic, salazinic, norstictic (traces) acids.

Xylographa hians Willey ex Tuck. – K9, AZ, LE L-29952, [R1], on wood of poles. Known from Kunashir Island (Chesnokov and Konoreva 2025). Contains norstictic acid.

X. opegraphella Nyl. ex Rothr. – K32, AZ, LE L-29953, [R1], on driftwood. Known from Kunashir Island (Chesnokov and Konoreva 2025). Contains norstictic and stictic (traces) acids.

Occurrence frequency

Most of the listed species fall into the single occurrence (R1, 85 species) and rare occurrence (R, 80 species) categories. Only 7 species (*Caloplaca gordejevii*, *Cladonia coniocraea*, *Graphis rikuzensis*, *Lecanora symmicta*, *Parmelia fertilis*, *Parmelia squarrosa*, *Ramalina roesleri*) are classified as occasionally occurring (O). All higher occurrence categories are unoccupied. The reasons for this may equally be the high diversity of habitats (see introduction) and the incomplete identification of diversity in the course of this study. All 7 listed species are quite common, and are common in various forest communities on a wide range of substrates (bark of coniferous, broad-leaved and small-leaved trees, as well as vines and shrubs). The fact that this list includes only species of forest communities indicates the predominance of various forest kinds on Kunashir over communities of other types (rock, ground, anthropogenic, etc.).

Analyzing the occurrence of species exclusively in forest communities, we obtain 52 single (R1), 38 rare (R) and 20 occasional (O) species. 8 species (*Buellia disciformis*, *Caloplaca gordijevii*, *Cladonia coniocraea*, *Graphis rikuzensis*, *Lecanora pulicaris*, *Platismatia interrupta*, *Ramalina roesleri*, *Tephromela atra* and *Usnea diffracta*) in such classification are frequent (F) and 2 (*Parmelia fertilis* and *P. squarrosa*) are common (C).

A general characteristic of ecological confinement of lichen species

The coastal dunes of Kunashir Island are characterized by such terrestrial species as *Cladonia arbuscula*, *C. furcata* and *C. rangiferina*. Volcanic areas are predominated by *Cladonia vulcani* and *C. crispata*. On the bark of coniferous (*Abies sachalinensis*, *Picea ajanensis*, *P. glehnii*), broad-leaved (*Quercus crispula*, *Acer mayrii*) and small-leaved (*Betula ermanii*, *Salix udensis*, *Alnus hirsuta*) trees, the most common lichen species are *Biatora albohyalina*, *Buellia disciformis*, *Caloplaca gordijevi*, *Lecanora pulicaris*, *Megalospora tuberculosa*, *Parmelia fertilis*, *P. squarrosa*, *Thelotrema lepadinum*, *Ramalina roesleri*, *Usnea diffracta*. On fallen trees and at the base of trunks, *Cladonia gracilis* subsp. *turbinata* and *C. coniocraea*, as well as *Peltigera neckeri*, are often found. *Lecanora strobilina*, *L. symmicta* and *Parmelia fertilis* grow on rose bush branches. On coastal rocks and cliffs, the most common species are *Hydropunctaria maura* (in the intertidal zone), *Lecanora caesiosora* and *Polycauliona verruculifera*, *Lecanora strobilina* and *Xylographa hians* are found on driftwood and old industrial wood. *Porpidia crustulata* is found in large numbers on inland stones, including pumice. *Flavoplaca flavocitrina* and *Rusavskia elegans* are found on concrete.

There are also 8 species of lichens (*Bryocaulon pseudosatoanum*, *Cetreliopsis asahinae*, *Cladonia vulcani*, *Hypogymnia fragillima*, *Lobaria pulmonaria*, *Menegazzia nipponica*, *M. subsimilis*, *Nephromopsis laii*), included in the Red Books of the Russian Federation (The Red… 2024) and the Sakhalin Region (The Red… 2019), and *Usnea diffracta*, included only in the Red Book of the Sakhalin Region (The Red… 2019). *Bryocaulon pseudosatoanum*, *Hypogymnia fragillima*, *Menegazzia subsimilis*, *M. nipponica* and *Nephromopsis laii* prefer the bark of coniferous trees in coniferous and coniferous-broadleaf forests. *Cetreliopsis asahinae* and *Lobaria pulmonaria* are more common on the bark of broad-leaved trees. *Usnea diffracta* inhabits the bark of conifers, birch and oak. *Cladonia vulcani* is abundant on the island, but is confined exclusively to the immediate vicinity of volcanoes. Here it grows on soil, rocks and branches of dwarf pine.

The sample plots K7, K15, K30 exhibited the highest diversity (38-46 species each). These are fairly old-growth communities, characterized by the highest level of humidity on the island and fairly good lighting. These are sparse coniferous, broad-leaved and coniferous-broad-leaved forests in the area of Lake Peschanoye, surrounding the lowest isthmus of the island (SP are located 26-74 meters above sea level). Sample plots in coniferous-small-leaved and small-leaved forests turned out to be less diverse (12-20 species each, probably due to the younger age of the forest stand. Other communities on the island exhibited significantly lesser lichen diversity (1-10 species per SP) due to the low representation and the low diversity of microniches inside them. These communities include dunes, dwarf pine, anthropogenic communities and rock communities, with the latter being poorly represented in the southern part of the island.

The association of lichen species with different substrates is shown in Table 2. The largest number of species (40) was collected from the bark of *Abies sachalinensis*. It is followed by species, collected from the bark of *Betula ermanii*, *Quercus crispula*, *Picea ajanensis*, *Salix udensis*, *Acer mayrii* and *Alnus hirsuta*. There is a small group of species confined exclusively to conifers (*Bryocaulon pseudosatoanum*, *Tetramelas triphragmioides*, *Usnea longissima*). Only a small number of species were found on almost all woody substrates.

Rocky substrate species are much less numerous. The greatest diversity is exhibited by species of stones or sea rocks. Pumice and concrete are inhabited mainly by non-substrate-specific species (*Flavoplaca flavocitrina*, *Porpidia crustulata*). The species composition of the soil, dunes and driftwood is also extremely poor.

Table 2. Number of species on different substrates

Substrate	Number of species	Number of sample plots
bark of *Abies sachalinensis*	40	7
bark of *Betula ermanii*	39	10
bark of *Quercus crispula*	32	2
bark of *Picea ajanensis*	30	3
bark of *Salix udensis*	27	3
bark of *Acer mayrii*	25	3
bark of *Alnus hirsuta*	25	5
bark of *Picea glehnii*	21	2
bark of *Magnolia obovata*	20	2
stones	17	8
bark of *Acer ukurunduense*	13	1
bark of *Kalopanax septemlobus*	12	1
rocks	12	7
wood of *Abies sachalinensis*	11	1
bark of *Sorbus commixta*	11	2
bark of *Hydrangea arborescens*	10	3
bark of *Padus ssiori*	10	1

Substrate	**Number of species**	**Number of sample plots**
bark of *Rosa rugosa*	10	1
sand	9	3
bark of *Phellodendron amurense*	8	1
wood of *Picea ajanensis*	8	1
bark of *Populus tremula*	8	2
bark of *Taxus cuspidata*	6	1
bark of *Hydrangea hydrangioides*	5	1
concrete	5	2
bark of *Fraxinus mandshurica*	4	1
driftwood	4	4
soil	4	5
wood of buildings	4	3
bark of *Sambucus kamtschatica*	3	2
bark of *Toxicodendron orientale*	3	2
bark of *Aralia* sp.	2	1
bark of *Pinus pumila*	2	3
pumice	2	3
thalli of lichens	2	3
bark of *Ulmus lacinata*	1	1

Non-metric multidimensional scaling (NMDS) of the sample plots depending on the similarity of the species composition of lichens was also carried out. The influence of such factors as altitude, distance from the sea coast, community type and the location of the sample plot on the Sea of Okhotsk or Pacific coast was considered. Thus, using the "envfit" function, it was found that the diversity of lichen species on sample plot is reliably affected only by belonging to a particular community (P=0.001, R^2=0.83, stress=0.05, k=2, number of random starts is 304). Below is a graph showing the location of the sample plots and substrates in the space of the hypothetical axes NMDS1 and NMDS2 (Fig. 6). The axes correspond to NMDS parameter values which have no observable connection to any of the initial parameters (altitude above sea level, distance from the coast). The closer the points representing sample plots are on the graph, the more similar the species composition of lichens on them is. Sample plots from similar communities form quite noticeable clusters on the graph, marked with colored circles.

In an isolated view of only woodland-based sample plots, the community factor also plays a significant role (P=0.009, R^2=0.74, stress=0.09, k=2, number of random starts is 484) (Fig. 7). The altitude factor does not have a significant effect, perhaps because the altitude range in this part of the island is not very large (from 0 to 888 m above sea level). The distance from the coast also does not have a significant effect, since, probably, all parts of the rather narrow island experience marine influence to some extent. We also did not find significant differences between the Pacific and Okhotsk Sea coasts. Perhaps with more data the differences between them will become clearer. The most distinct lichen composition is found in the sample plots that are more exposed to the influence of volcanoes – the dwarf pine communities (K16, 23) and the monospecific community of Glen spruce (K21) in the vicinity of the Golovnin volcano (underlined in Fig. 7). The NMDS1 axis may reflect some combination of the amount of insolation and humidity. This is because the Glen spruce community (K21) is the darkest and most humid, while the dwarf pine communities (K16, 23) are dry and well-lit. The significance of the NMDS2 axis is less clear, but it may partially reflect belonging to different community types.

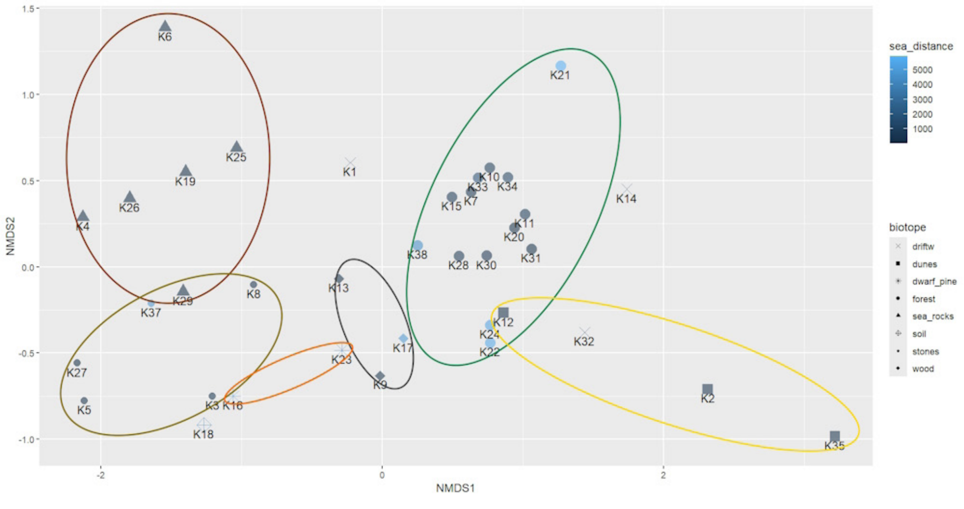

Figure 6. Non-metrical multidimensional scaling of sample plots. The forest sample plots are outlined in green, rocky areas in brown, stony areas in dark yellow, dunes in yellow, building wood in grey, and dwarf pine in orange.

An analysis was also made of the dependence of the species composition of lichens on the arboreal substrate where they were collected. The influence of such factors as smoothness of substrate (with two categories: smooth or rough), its pH and coniferous or deciduous nature of the substrate was considered. The latter factor plays a significant role (P=0.001, R^2=0.2432, stress=0.16, k=2, number of random starts is 42), as well as pH (P=0.002, R^2=0.4832) (Fig. 8). Bark pH data for the Far East are taken from the article by Makryi and Skirina (2020). At the same time, the smoothness of the bark does not have a significant effect. For substrates, fairly well-defined clusters of coniferous species with low pH and deciduous species with bark with acidity close to neutral are visible. Each point of the diagram depicts a substrate. The closer the points on the graph are, the closer the species composition of lichens on these substrates. Elm bark is located separately from the other deciduous species, but this is probably due to the fact that elm was encountered only at one sample plot, and a small number of species were collected from it. The NMDS1 axis partly shows substrate pH, and NMDS2 axis may show substrate wood hardness.

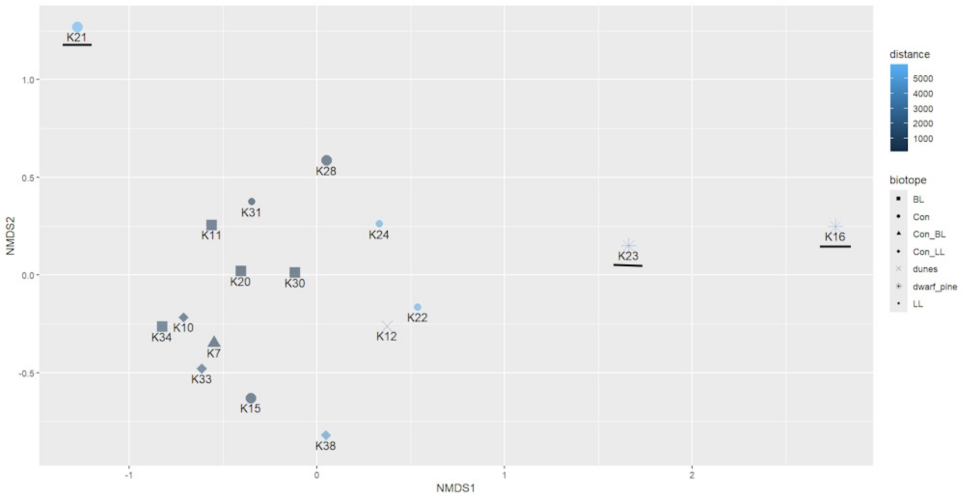

Figure 7. Non-metrical multidimensional scaling of trees and shrubs sample plots. Sample plots near the volcanoes are underlined.

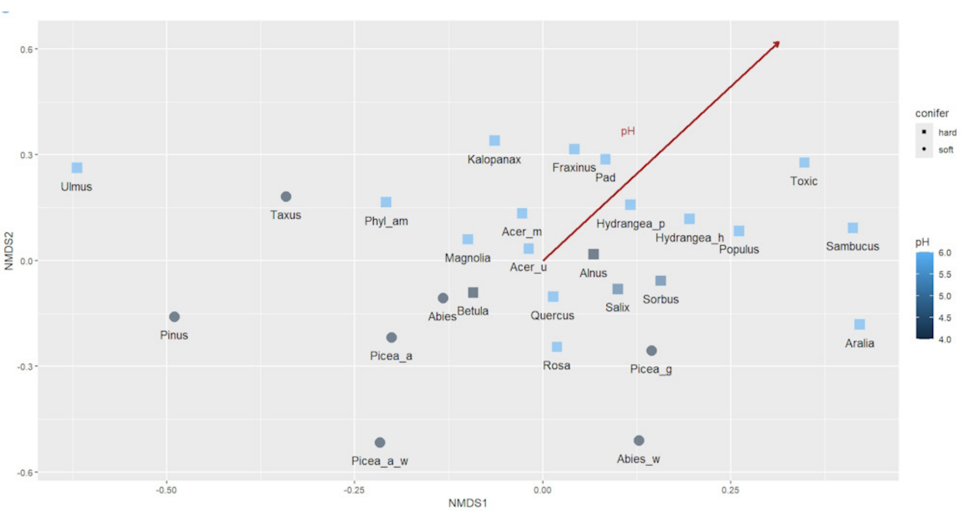

Figure 8. Non-metrical multidimensional scaling of wood substrates.

Conclusions

In this study provides data of 172 species of lichens and allied fungi. Two species are new for Russia, 3 are new for the Russian Far East, 13 are new for the Sakhalin Region, 6 are new for the Kuril Islands and 37 are new for Kunashir Island.

The most common species are *Caloplaca gordejevii*, *Cladonia coniocraea*, *Graphis rikuzensis*, *Lecanora symmicta*, *Parmelia fertilis*, *P. squarrosa*, *Ramalina roesleri*. The fact that this list includes only species of forest communities indicates the predominance of various forest kinds on Kunashir Island over communities of other types (rock, ground, anthropogenic, etc.).

The sample plots K7, K15, K30 exhibited the highest diversity (38-46 species each). These are sparse coniferous, broad-leaved and coniferous-broad-leaved forests in the area of Lake Peschanoye, surrounding the lowest isthmus of the island.

The most reach substrates on the island are bark of *Abies sachalinensis*, *Betula ermanii*, *Quercus crispula*, *Picea ajanensis*, *Acer mayrii*, *Alnus hirsuta* and *Salix udensis* (25–40 lichen species).

Using non-metric multidimensional scaling (NMDS) of the sample plots depending on the similarity of the species composition of lichens, we found that at the landscape level, the species composition on a sample plot is reliably affected only by belonging to a particular community. The altitude and distance from the coast do not have a significant effect according to our data. We also did not find significant differences between the Pacific and Okhotsk Sea coasts. The most distinct lichen compositions in forest and shrubs communities are found in the sample plots that are more exposed to the influence of volcanoes.

The composition of lichen species depends significantly on substrate characteristics, particularly pH and the distinction between coniferous and deciduous substrates.

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