

LICHENS — ЛИШАЙНИКИ

Addition to the lichen flora of Iturup Island (Sakhalin Region, Russian Far East)

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Abstract. As a result of expeditionary investigations on Iturup Island (southern group of islands of the Kuril archipelago), 61 species of lichens were identified as new to the island, including *Porpidia contraponenda* and *Xylographa rubescens* — new to the Russian Far East, and *Amandinea coniops* and *Arthonia dispuncta* — new to the South of the Russian Far East. Six species are new to the Sakhalin Region. The difference in species composition of the Sea of Okhotsk coast and the Pacific coast of Iturup Island is briefly discussed.

Keywords: distribution of lichens, new records, Kuril Islands.

Дополнение к флоре лишайников острова Итуруп (Сахалинская область, Дальний Восток, Россия)

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Резюме. В результате экспедиционных исследований на о. Итуруп (южная группа островов Курильского архипелага) был выявлен 61 новый для острова вид лишайников, среди которых *Porpidia contraponenda* и *Xylographa rubescens* впервые приводятся для Дальнего Востока России, *Amandinea coniops* и *Arthonia dispuncta* — для юга Дальнего Востока России. Шесть видов являются новыми для Сахалинской обл. Кратко обсуждается различие видового состава лишайников побережья Охотского моря и тихоокеанского побережья о. Итуруп.

Ключевые слова: новые находки, распространение лишайников, Курильские острова.

The Russian Far East is characterized by a variety of climatic conditions and high biological diversity (Bogacheva *et al.*, 2018). A large number of endemic plant species, fungi, and lichens are concentrated in the south of the Russian Far East. Some of them

are included in the Red Data Book of Russia (Krasnaya..., 2008b) and regional Red Data Books (Krasnaya..., 2008a, 2019a, b, c, d). Nevertheless, the area remains poorly studied in lichenological terms, despite the 120-year history of research (e.g., Elenkin, 1902; Satô, 1936; Mikulin, 1989; Yakovchenko *et al.*, 2013; Davydov *et al.*, 2021). It is indicated by a large number of recently described species (e.g., Zhurbenko *et al.*, 2017; Gerasimova *et al.*, 2018; Frolov *et al.*, 2021) and rare species found in the last five years (e.g., Sheard *et al.*, 2017; Ezhkin, Schumm, 2018; Konoreva *et al.*, 2019, 2020; Tchabanenko *et al.*, 2018) mainly from the Sakhalin Region.

Iturup is the largest island among the Kuril Islands. It is part of the southern Kuril Islands and is located between the islands of Kunashir and Urup. The Kuril Islands belong to the Sakhalin Region and are located between the Kamchatka Peninsula and Hokkaido Island. The climate of the island is temperate maritime with monsoon features. The Sea of Okhotsk coast is influenced by the warm waters of the Soya Current, the Pacific Ocean coast is noticeably colder, which is why there are strong differences in the flora and fauna of the coasts (Lyashchevskaya, Ganzei, 2011; Razzhigaeva *et al.*, 2013). The relief of the island is composed of volcanic massifs and mountain ranges. There are 20 volcanoes on the island, 9 of which are active. Most of the island is covered with coniferous forests of *Picea jezoensis* (Siebold et Zucc.) Carrière and *Abies sachalinensis* (F. Schmidt) Mast.; in the central part, *Larix cajanderi* Mayr grows. In the south of the island there are broad-leaved species: *Quercus crispula* Blume, *Acer* spp., *Kalopanax septemlobus* (Thunb.) Koidz. etc. Dense thickets of *Sasa kurilensis* (Rupr.) Makino et Shibata often make forests and open mountain slopes impassable (Gvozdetsky, Mikhailov, 1963). Not surprisingly, this diversity of habitats should correlate with the high diversity of lichen flora.

The history of research of lichen flora of Iturup Island is about 55 years old. A total of 162 lichen species were known at the beginning of our research. Mainly this information concerns separate taxa registered on the island (Rassadina, 1967; Trass, 1979; Moberg, 1995; Dombrovskaya, 1996; Dobrysh, 1999; Joneson *et al.*, 2004; Tchabanenko, 2006, 2018; Titov, 2006; Kondratyuk *et al.*, 2013; Sheard *et al.*, 2017; Ezhkin, Jørgensen, 2018; Konoreva *et al.*, 2018a, 2021; Galanina, Ezhkin, 2019; Popov *et al.*, 2020; Ezhkin, Davydov, 2021; Kuznetsova *et al.*, 2021). However, there are few studies on the lichen flora of Iturup Island (Tchabanenko, 2002; Ezhkin *et al.*, 2015; Bogacheva *et al.*, 2018; Konoreva *et al.*, 2018b; 2020; Tolpysheva, Varlygina, 2021).

Material and Methods

The lichen specimens presented in the paper were collected by Liudmila Konoreva (LK) and Sergey Chesnokov (SC) in Iturup Island in August 2017. Most of the collections were made in the southern part of the island (Ostrovnoy Reserve) (Fig. 1). In total, we collected about 500 specimens and processed about 260 of them. All geographical coordinates are given in the coordinate system WGS 1984. The laboratory study was carried out according to the standard technique (Smith *et al.*, 2009) in the Laboratory of Lichenology and Bryology of the Komarov Botanical Institute of the Russian Aca-

demy of Sciences (BIN RAS) using a binocular stereoscopic microscope MSP 1 var. 2, transmitted light microscope Zeiss Primo Star, a standard set of chemical reagents for carrying out color spots reactions for the presence of certain groups of lichen substances in thalli. The nomenclature of lichens mainly follows Rassadina (1967), Mongkolsuk *et al.* (2015), Kondratyuk *et al.* (2020), and Westberg *et al.* (2021).

All collected and identified specimens are stored in the herbaria of the Laboratory of Lichenology and Bryology, Komarov Botanical Institute (LE), Botanical Garden-Institute of the Far Eastern Branch of the Russian Academy of Sciences (VBGI), University of Helsinki (H), and Institute of Experimental Botany of National Academy of Sciences of Belarus (MSK).

List of localities

Sakhalin Region, Kuril District, Iturup Island. Surroundings of Kurilsk: 1 – 45°12'49.5"N, 147°51'21.6"E, 7 m a. s. l., rocks on the coast of the Sea of Okhotsk, 12 VIII 2017. **Ostrovnoy Reserve, Odesskiy Bay:** 2 – 44°47'58.7"N, 147°13'46.5"E, 17 m a. s. l., fir forest with *Sasa kurilensis*, 13 VIII 2017; 3 – 44°47'57.7"N, 147°13'43.6"E, 14 m a. s. l., edge of the fir forest, 13 VIII 2017; 4 – 44°47'49.7"N, 147°11'32.4"E, 22 m a. s. l., willow-rowan forest, 13 VIII 2017. **Neighborhood of Lesozavodskoy village:** 5 – 44°45'51.2"N, 147°11'13.3"E, 10 m a. s. l., rocky coast of solidified lava in fir forest, 14 VIII 2017; 6 – 44°46'04.4"N, 147°11'13.4"E, 21 m a. s. l., mixed forest near lake, 14 VIII 2017; 7 – 44°46'02.1"N, 147°11'41.5"E, 21 m a. s. l., fir forest with *Sasa kurilensis*, 14 VIII 2017; 8 – 44°46'07.7"N, 147°11'47.9"E, 18 m a. s. l., fir forest with *Acer* sp. and *Sasa kurilensis*, 14 VIII 2017; 9 – 44°47'10.3"N, 147°12'19.7"E, 28 m a. s. l., road in fir forest, 14 VIII 2017. **Stokap Volcano, Kraterny Creek:** 10 – 44°51'01.0"N, 147°16'25.9"E, 122 m a. s. l., rocks in valley of creek, 15 VIII 2017; 11 – 44°50'40.6"N, 147°17'10.3"E, 266 m a. s. l., alder-rowan forest along the bank of stream, 15 VIII 2017; 12 – 44°50'15.9"N, 147°18'24.5"E, 505 m a. s. l., thickets of maple and poplar on the right bank of stream, 15 VIII 2017; 13 – 44°50'25.9"N, 147°17'44.7"E, 369 m a. s. l., fir forest on slope, 15 VIII 2017; 14 – 44°51'16.0"N, 147°16'00.7"E, 38 m a. s. l., maple-oak-fir forest, 15 VIII 2017. **Neighborhood of Iodny Cape:** 15 – 44°43'15.4"N, 147°21'15.0"E, 1 m a. s. l., rocky islet on the shore of the Pacific Ocean, 16 VIII 2017; 16 – 44°43'32.3"N, 147°20'18.4"E, 60 m a. s. l., willow near the old road, 16 VIII 2017; 17 – 44°43'40.3"N, 147°19'41.2"E, 67 m a. s. l., willow-birch forest with *Sasa kurilensis* along the old road, 16 VIII 2017; 18 – 44°43'23.5"N, 147°21'05.6"E, 11 m a. s. l., rowan-willow floodplain forest near the stream, 17 VIII 2017; 19 – 44°43'22.0"N, 147°20'53.3"E, 15 m a. s. l., willow-alder forest along the old road, 17 VIII 2017; 20 – 44°43'23.7"N, 147°21'31.5"E, 30 m a. s. l., Iodny village, abandoned border post, 17 VIII 2017.

Results and Discussion

In the course of our research, we identified 115 species of lichens and one lichenicolous fungus (marked "+"), 61 of which are new to Iturup Island and are listed below. *Porpidia contraponenda* and *Xylographa rubescens* are new to the Russian Far East (marked "!"), *Amandinea coniops* and *Arthonia dispuncta* are new to the South of the Russian Far East (marked "***"). *Epicleadonia stenospora*, *Melanelixia subaurifera*, *Mycobilimbia tetramera*, *Parmelia asiatica*, *Polycauliona candelaria*, *P. verruculifera* are new to the Sakhalin Region (marked "*"). To date, along with our new data, the list of lichens of Iturup Island includes 223 species.

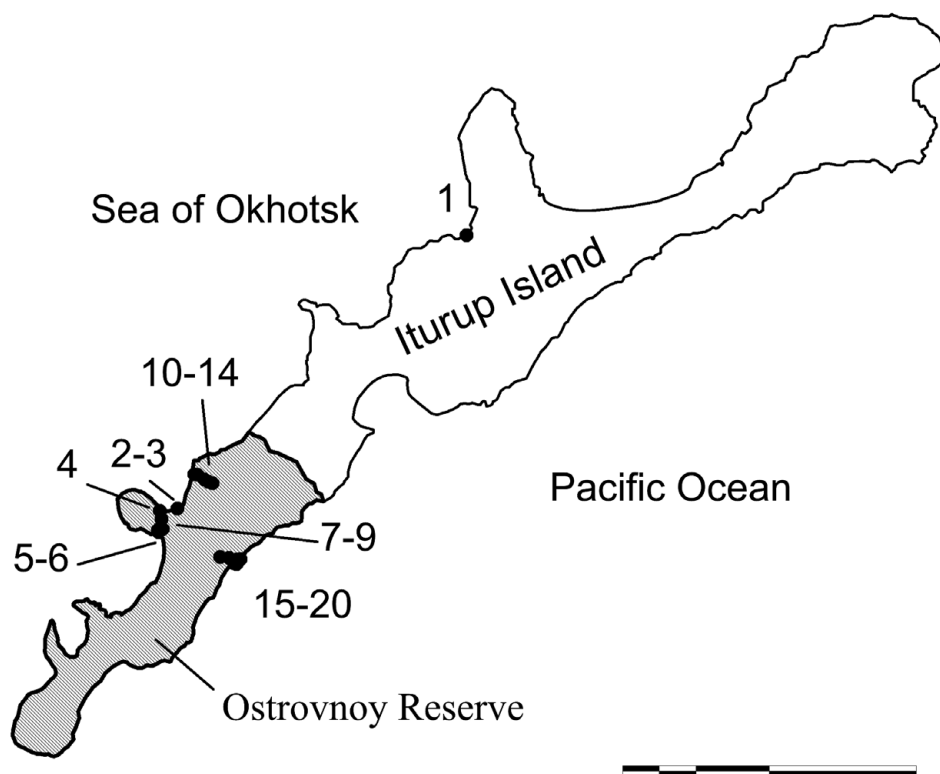


Fig. 1. Map of the study area with sampling plots. Scale bar: 50 km.

****Amandinea coniois** (Wahlenb.) M. Choisy ex Scheid. et H. Mayrhofer – 1, on stone, LK 549, LE. In the Russian Far East, the species is known from Kamchatka Territory (Himmelbrant *et al.*, 2021) and Chukotka Autonomous Area (Kristinsson *et al.*, 2010).

****Arthonia dispuncta** Nyl. – 2, on bark of *Salix* sp., SC 257, LE. The species is reported for the north of the Russian Far East (Spisok..., 2010), but without exact location.

A. punctiformis Ach. – 18, on bark of *Sorbus* sp., SC 304, VBGI 111826.

A. radiata (Pers.) Ach. – 10, on bark of *Kalopanax septemlobus*, LK 608, VBGI 111844; 13, on bark of *Abies sachalinensis*, LK 620, LE.

A. spadicea Leight. – 11, on bark of *Alnus* sp., SC 284, VBGI 111837; 13, on bark of *Abies sachalinensis*, LK 620, LE.

Biatora chrysantha (Zahlbr.) Printzen – 11, on mosses and deadwood, LK 610, LE.

B. efflorescens (Hedl.) Räsänen – 2, on bark of *Salix* sp., SC 257, LE; 5, on bark of *Sorbus* sp., SC 270, LE; 18, on bark of *Salix* sp., LK 655, VBGI 111834.

Bilimbia sabuletorum (Schreb.) Arnold – 11, on mosses, LK 614, VBGI 111841.

Bryoria furcellata (Fr.) Brodo et D. Hawksw. – 16, on bark of *Salix* sp., LK 640, VBGI 111849; 19, on bark of *Betula* sp., SC 307, VBGI 111804.

Caloplaca gordejvii (Tomin) Oxner – 2, on bark of *Salix* sp., LK 560, VBGI 111852, SC 257, LE; 14, on bark of *Quercus crispula*, LK 623, LE; 17, on deadwood, LK 644, VBGI 111747, on bark of *Salix* sp., SC 299, LE; 18, on bark of *Salix* sp., LK 654, VBGI 79354 and SC 303, LE.

Cladonia coniocraea (Flörke) Spreng. — 5, on rotten wood, *LK* 575, VBG 111818, on bark of *Abies sachalinensis*, *SC* 268, VBG 79368; 18, on bark of *Salix* sp., *LK* 656, LE.

C. digitata (L.) Hoffm. — 2, on rotten wood of *Abies sachalinensis*, *SC* 259, VBG 79383.

Cliostomum griffithii (Sm.) Coppins — 6, on bark of *Abies sachalinensis*, *SC* 272, LE.

Coenogonium luteum (Dicks.) Kalb et Lücking — 10, on stone, *SC* 280, LE.

C. pineti (Ach.) Lücking et Lumbsch — 2, on bark of *Salix* sp., *SC* 257, VBG 111814; 5, on stump, *LK* 575, VBG 79367, on soil, *SC* 267, LE; 13, on soil near the roots of *Abies sachalinensis*, *SC* 286, VBG 111817.

Collema complanatum Hue — 17, on bark of *Salix* sp., *LK* 647, LE.

*+**Epicladonia stenospora** (Harm.) D. Hawksw. — 19, on the primary thallus of *Cladonia* sp., *LK* 667, LE. In the Russian Far East, the species is known from Kamchatka Territory (Zhurbenko *et al.*, 2012), Khabarovsk and Primorye territories, Chukotka Autonomous Area (Zhurbenko, Pino-Bodas, 2017).

Evernia mesomorpha Nyl. — 19, on bark of *Betula* sp., *LK* 665, LE and *SC* 307, VBG 111808.

Hypogymnia pseudophysodes (Asahina) Rass. — 2, on twigs of *Abies sachalinensis*, *LK* 557, VBG 111730.

H. submundata (Oxner) Rass. — 18, on bark of *Salix* sp., *SC* 303, LE.

H. vittata (Ach.) Parrique — 17, on deadwood, *LK* 644, LE; 19, on bark of *Betula* sp., *SC* 307, VBG 111811.

Lecanora argentata (Ach.) Malme — 19, on bark of *Sambucus* sp., *SC* 308, LE.

L. pulcaris (Pers.) Ach. — 18, on bark of *Sorbus* sp., *SC* 304, VBG 111830.

Lecidea albohyalina (Nyl.) Th. Fr. — 4, on bark of *Salix* sp., *LK* 564, LE; 11, on bark of deadwood, *LK* 610, LE, on bark of *Kalopanax septemlobus*, *LK* 615, VBG 111820; 13, on bark of *Quercus crispula*, *LK* 621, LE.

L. berengeriana (A. Massal.) Nyl. — 2, on bark of *Salix* sp., *SC* 257, LE; 13, on bark of coniferous deadwood, *LK* 622, LE.

Lendemeriella borealis (Vain.) S. Y. Kondr. — 2, on bark of *Betula* sp., *LK* 556, LE, on bark of *Salix* sp., *SC* 257, LE, on bark of *Sorbus* sp., *SC* 260, LE, on bark of *Acer* sp., *SC* 261, LE; 5, on twigs of *Abies sachalinensis*, *LK* 572, LE, on bark of *Sorbus* sp., *SC* 270, LE; 13, on bark of *Abies sachalinensis*, *LK* 620, LE and *SC* 287, LE.

Leptogium burnetiae C. W. Dodge — 8, on bark of *Kalopanax septemlobus*, *LK* 598, LE.

L. cyanescens (Rabenh.) Körb. — 3, on bark of *Acer* sp., *LK* 563, LE; 4, on bark of *Salix* sp., *LK* 564, LE; 17, on deadwood, *LK* 643, VBG 111744, on bark of *Salix* sp., *SC* 298, LE, *LK* 642, VBG 111742, *LK* 647, VBG 111737; 18, on bark of *Salix* sp., *LK* 654, VBG 79353, *LK* 655, VBG 111833, *LK* 656, LE, *SC* 302, 303, LE; 19, on bark of *Salix* sp., *SC* 305, VBG 79356, *SC* 306, LE, *LK* 663, LE.

Megalospora tuberculosa (Fée) Sipman — 11, on bark of *Alnus* sp., *SC* 284, LE.

Melanelixia huei (Asahina) O. Blanco *et al.* — 2, on bark of *Salix* sp., *LK* 560, VBG 111854, *SC* 257, VBG 111813; 4, on bark of *Salix* sp., *LK* 565, LE, on bark of *Sorbus* sp., *SC* 262, VBG 111823; 18, on bark of *Salix* sp., *LK* 656, LE, on bark of *Sorbus* sp., *SC* 304, VBG 111829.

***M. subaurifera** (Nyl.) O. Blanco *et al.* — 5, on bark of *Abies sachalinensis*, *SC* 263, LE. In the Russian Far East the species is known from Khabarovsk Territory (Mikulín, 1989).

Melanohalea septentrionalis (Lynge) O. Blanco *et al.* — 2, on bark of *Salix* sp., *LK* 560, LE.

Menegazzia nipponica K. H. Moon *et al.* — 8, on bark of *Abies sachalinensis*, *SC* 276, LE, *LK* 597, VBG 79364.

- Micarea denigrata** (Fr.) Hedl. — 20, on wood, *LK 670*, LE.
- M. prasina** Fr. s. str. — 13, on rotten wood of *Abies sachalinensis*, *SC 286*, H.
- Miriquidica leucophaea** (Flörke ex Rabenh.) Hertel et Rambold — 1, on stone, *LK 547*, VBG 111734; 15, on stone, *LK 628*, LE.
- ***Mycobilimbia tetramera** (De Not.) Clauzade et al. — 11, on bark of *Kalopanax septemlobus*, *LK 615*, LE. In the South of the Russian Far East the species is known from Amur Region (Tolpysheva, Zhiryakova, 1988) and Jewish Autonomous Region (Skirina, 2015b).
- Nephroma resupinatum** (L.) Ach. — 17, on deadwood, *LK 643*, VBG 111743, on bark of *Salix* sp., *LK 647*, VBG 111740; 18, on bark of *Salix* sp., *LK 655*, VBG 111835.
- Nephromopsis laii** (A. Thell et Randlane) Saag et A. Thell — 9, on deadwood, *LK 600*, LE; 11, on bark of *Alnus* sp., *LK 609*, MSK-L.
- Normandina pulchella** (Borrer) Nyl. — 17, on bark of *Salix* sp., *SC 299*, LE; 19, on bark of *Salix* sp., *SC 305*, VBG 79357, *306*, LE.
- Pannaria lurida** (Mont.) Nyl. — 17, on bark of *Salix* sp., *LK 642*, VBG 111741; 19, on bark of *Salix* sp., *LK 663*, LE.
- ***Parmelia asiatica** A. Crespo et Divakar — 6, on bark of *Abies sachalinensis*, *SC 272*, LE. In the Russian Far East the species is known from Kamchatka Territory (Lishtva *et al.*, 2013), Amur (Kuznetsova, Dudov, 2017) and Magadan (Zheludeva, 2015) regions.
- Peltigera collina** (Ach.) Schrad. — 17, on bark of *Salix* sp., *SC 300*, VBG 77922.
- P. degenii** Gyeln. — 5, on bark of *Abies sachalinensis*, *SC 269*, LE, on mosses, *LK 582*, VBG 111815; 7, on soil, *LK 584*, VBG 111845; 8, on bark of *Acer* sp., *LK 596*, VBG 79379.
- P. extenuata** (Nyl. ex Vain.) Lojka — 19, on bark of *Sambucus* sp., *SC 308*, VBG 79349.
- P. polydactylon** (Neck.) Hoffm. — 7, on deadwood of *Abies sachalinensis*, *LK 593*, LE.
- P. praetextata** (Flörke ex Sommerf.) Zopf — 4, on bark of *Salix* sp., *LK 564*, LE.
- Phaeophyscia hispidula** (Ach.) Essl. — 19, on bark of *Sambucus* sp., *SC 308*, VBG 79351.
- P. squarrosa** Kashiw. — 12, on bark of *Acer* sp., *LK 617*, LE.
- Polyblastidium hypoleucum** (Ach.) Kalb — 12, on bark of *Acer* sp., *LK 617*, LE.
- P. microphyllum** (Kurok.) Kalb — 13, on bark of *Abies sachalinensis*, *SC 287*, LE.
- ***Polycauliona candelaria** (L.) Frödén et al. — 1, on stone, *LK 545*, LE. In the South of the Russian Far East the species is known from Khabarovsk (Mikulín, 1989) and Primorye Territories (Tchabanenko, 2002).
- ***P. verruculifera** (Vain.) Arup et al. — 1, on stone, *LK 545*, LE; 5, on stone, *LK 566*, LE; 15, on stone, *LK 629*, LE. In the Russian Far East the species is known from Khabarovsk and Kamchatka Territories (Frolov, Gagarina, 2020; Himelbrant *et al.*, 2021).
- !Porpidia contraponenda** (Arnold) Knoph et Hertel — 10, on stone, *LK 604*, VBG 111735. The nearest known locality in Russia is in Murmansk Region (Kristinsson *et al.*, 2010). In Asia the nearest known locality is in Malaysia (Paukov *et al.*, 2017).
- Pseudoschismatomma rufescens** (Pers.) Ertz et Tehler — 6, on bark of *Abies sachalinensis*, *SC 272*, LE.
- Rinodina excrescens** Vain. — 17, on bark of *Salix* sp., *LK 647*, VBG 111739.
- R. subparieta** (Nyl.) Zahlbr. — 5, on bark of *Sorbus* sp., *SC 270*, LE; 19, on bark of *Salix* sp., *SC 306*, LE.
- Scoliosporum chlorococcum** (Graewe ex Stenh.) Vězda — 2, on twigs of *Abies sachalinensis*, *LK 557*, VBG 111730; 18, on bark of *Salix* sp., *LK 655*, VBG 111834, on bark of *Sorbus* sp., *SC 304*, VBG 111828.
- Usnea diffracta** Vain. — 18, on bark of *Salix* sp., *LK 656*, VBG 79370, *SC 303*, LE.

Xanthoparmelia conspersa (Ach.) Hale — 15, on stone, LK 628, VBG 79355, SC 291, LE.

!**Xylographa rubescens** Räsänen — 20, on wood, LK 670, LE. The nearest known locality is in Altai Republic (Spribille *et al.*, 2014).

Most of the lichen species new to Iturup are common and widespread in the Russian Far East, which shows our insufficient knowledge of the lichen diversity on the island. It is the largest island in the southern group of the Kuril archipelago, with an area of 3187 km². The area of the second largest island in the southern group of the Kuril archipelago (Kunashir) is more than two times smaller (1490 km²). However, the list of lichens on Kunashir Island to date includes 373 species (Tchabanenko, 2002; Ezhkin, Kordyukov, 2016; Bogacheva *et al.*, 2018; Ezhkin, Schumm, 2018; Gerasimova *et al.*, 2018; Ezhkin, 2019, 2020; Galanina, Ezhkin, 2019), which is 1.5 times more than the list of the known species for Iturup Island (223). This is primarily due to the poor accessibility of the Iturup Island for researchers.

According to our preliminary data the lichens on the Sea of Okhotsk coast of Iturup Island are of the greater interest. We identified 66 species for the Pacific Ocean coast and 80 species for the Sea of Okhotsk coast. Most of the lichens collected on the Pacific Ocean coast are widespread boreal species that do not occur on the Sea of Okhotsk coast, for example, *Bryoria furcellata*, *Cladonia macilenta*, *Evernia mesomorpha*, *Hypogymnia vittata*, *Lecanora pulicaris*, *Nephroma parile*, *Peltigera collina*, and *Rhizoplaca melanophthalma*. We believe, this is due to more severe conditions in the Pacific Ocean coast area. Whereas, due to the influence of the warm Soya current on the Sea of Okhotsk coast more favorable conditions are formed, which makes possible the presence here of asian species such as *Anzia colpodes* (Ach.) Stizenb., *Coenogonium isidiatum* (G. Thor et Vězda) Lücking *et al.*, *Lobaria spathulata* (Inumaru) Yoshim., *Megalospora tuberculosa*, *Menegazzia nipponica*, *Nipponoparmelia laevior* (Nyl.) K. H. Moon *et al.*, *Parmelia asiatica*, *Phaeophyscia squarrosa*, *Polyblastidium hypoleucum*, *P. microphyllum*. These species were not found on the Pacific Ocean coast. However, due to the scarcity of our data, this comparison of the two coasts is just preliminary. We suggest that further research will significantly supplement the list of lichens of Iturup Island and clarify the difference between the coasts.

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