

NEW RECORDS OF RARE AND OTHERWISE INTERESTING MOSSES FROM THE
USSURIJSKY STATE RESERVE (PRIMORSKY TERRITORY, RUSSIA)

НОВЫЕ НАХОДКИ РЕДКИХ И ИНТЕРЕСНЫХ МХОВ В УССУРИЙСКОМ
ЗАПОВЕДНИКЕ (ПРИМОРСКИЙ КРАЙ, РОССИЯ)

YURY S. ISHCENKO^{1,2}, ANNA V. SHKURKO¹ & OXANA I. KUZNETSOVA¹, ALINA V. FEDOROVA¹
& VLADIMIR E. FEDOSOV^{3,4},

ЮРИЙ С. ИЩЕНКО^{1,2}, АННА В. ШКУРКО¹, ОКСАНА И. КУЗНЕЦОВА¹, АЛИНА В. ФЕДОРОВА¹,
ВЛАДИМИР Э. ФЕДОСОВ^{3,4}

Abstract

Recent field studies in the Ussurijsky State Reserve brought numerous records of very rare species not found in the area before. *Oxyrhynchium vagans* is found in Russia for the first time. Collection of *Ignatovia microphylla*, recently described from the Lozovy Range in Primorsky Territory is the second one for this genus. *Symblepharis crispifolia* was reported previously from Russia, but their check with DNA found that most of records belong in fact to other species, thus the present record is the second for Russia. New locality of *Forsstroemia goughiana* is the third in Russia, and of *Homaliadelphus targionianus* fourth for Russia. New records of *Miyabea fruticella* and recently described *Glyphomitrium ambiguum* and *Pseudohygrohypnum orientale* are provided.

Резюме

Рассмотрены предварительные результаты обработки коллекции мхов из Уссурийского заповедника, собранной в 2022 году в трех основных точках – окрестностях стационаров Комарово-Заповедное, Аникин ключ и Пейшула. На территории заповедника выявлены многие уникальные виды мхов, в частности, *Ignatovia microphylla*, известная ранее только с хр. Лозовый в Приморском Крае, *Forsstroemia goughiana*, *Miyabea fruticella* и *Symblepharis crispifolia* (ранее известны по единичным находкам в Приморском Крае), занесенные в Красную Книгу РФ *Homaliadelphus targionianus* и *Hyophila involuta*, недавно описанные или выявленные в России *Glyphomitrium ambiguum*, *G. crispifolium*, *Pseudohygrohypnum orientale* и мн. др. *Oxyrhynchium vagans* впервые найден в России.

KEYWORDS: *Ignatovia microphylla*, *Symblepharis crispifolia*, *Forsstroemia goughiana*, East Asia, biodiversity, DNA-barcoding

INTRODUCTION

Ussurijsky State Nature Reserve is situated in the southern part of Primorsky Territory where it covers south-western low mountain spoor of the Sikhote-Alin' Range known as Przhevalskogo Mountains and adjacent foothill area. The relief is low montane, with altitudes varying within 100–700 meters above sea level. The slopes of mountains are mostly steep, sometimes convex, in the lower part sometimes gentle. The rocks are mainly of volcanic origin. The territory of the reserve is dominated by igneous rocks, such as basalts, andesitic and diabase porphyrites, and metamorphic rocks, represented by sandy shales, there are few sedimentary rocks, mainly dislocat-

ed siltstones and limestones of Zmeinaya Mountain, near the Koryavaya Pad' Creek (Azbukina *et al.*, 2006).

The territory of the reserve belongs to the region of the Far East monsoons and tropical cyclones – typhoons associated with heavy precipitation as rain, usually in summer or autumn. In winter, the location of the snow cover is uneven, the cover itself is low that contributes to deep freezing of the soil. The average annual precipitation in the reserve is 500–1200 mm. The average annual air humidity is 75–80%, the highest value of this indicator falls on the middle and end of summer, the lowest – in spring (Azbukina *et al.*, 2006).

Forest vegetation covers 99% of the reserve territory,

¹ – Tsitsin Main Botanical Garden, Russian Academy of Sciences, Botanicheskaja 4, Moscow 127276. E-mails: poorpoorpoorpool@gmail.com; shen-ku@bk.ru; oikuznets@gmail.com; alina_77777@mail.ru. ORCID (YuI) 0000-0001-8473-6813; (ASh) 0000-0001-7682-9323; (OK): 0000-0002-5513-1329; (AF): 0000-0001-7362-2124

² – Russian Biotechnological University, Talalikhina 33, Moscow 109029

³ – Lomonosov Moscow State University, Faculty of Biology, Ecology and Plant Geography Dept., Leninskie Gory Str. 1-12, Moscow 119234 Russia; E-mail: fedosov_v@mail.ru; ORCID: 0000-0002-5331-6346

⁴ – Botanical Garden-Institute, Far Eastern Branch of the Russian Academy of Sciences, Makovskogo Street, 142, Vladivostok, 690024, Russia

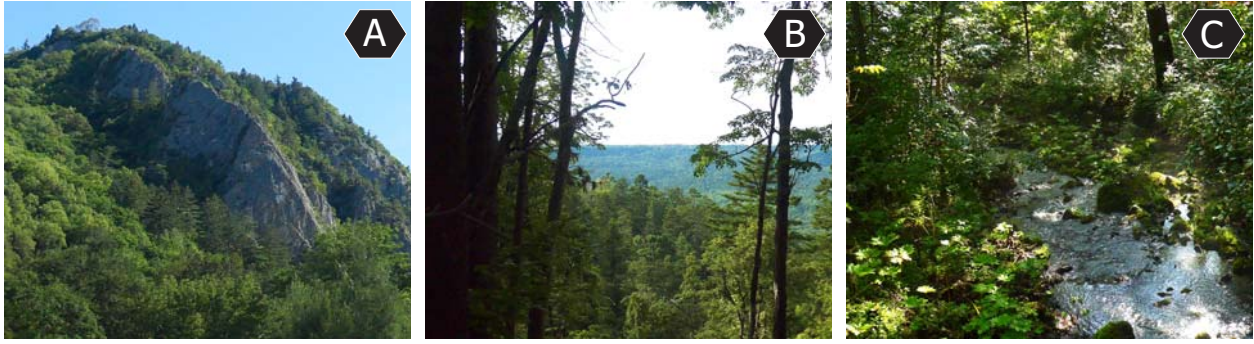


Fig. 1. Habitats of mosses in the Ussurijsky State Reserve: A: cliff at Zmeinaya Mountain; B: mixed pine-hardwood forest; C: Komarovka Creek and mixed forest in its valley.

coniferous forests prevail, and valley deciduous forests are less common. Forests are mostly formed by *Pinus koraiensis*, which mixes with other conifers; *Picea jezoensis*, *Abies nephrolepis* and *A. holophylla* are also widespread in the reserve, *Pinus densiflora*, *Juniperus rigida* and *J. davurica* occur on rock outcrops of Zmeinaya Mountain. The deciduous aspect of the forests is composed of a very diverse variety of species, which are most often mixed with conifers. Some species of the genera *Betula*, *Populus*, *Fraxinus* and *Ulmus*, *Corylus mandshurica*, *Alnus hirsuta*, *Quercus mongolica*, *Tilia amurensis*, *Phellodendron amurense*, *Maackia amurensis* and *Carpinus cordata*, a several *Salix* and *Acer* species are widespread (Azbukina *et al.*, 2006).

The area has rather rich history of bryological exploration. First bryophyte collections here were made by V.L. Komarov, they were identified by L.I. Savich (1923). In 1930ths bryophyte flora of the reserve was studied by a famous soviet bryologist A.S. Lazarenko; preliminary results of his studies (Lazarenko, 1936) included review of ecological distribution of the revealed bryophytes (mostly mosses) and biogeographic analysis of the revealed moss flora. Further he complemented his results by a new data which appeared in his treatment of bryophyte flora of Soviet Far East (Lazarenko, 1940, 1941a,b, 1945), where as many as 144 moss species are reported from the area. Further exploration of the moss flora of the reserve was conducted by L.V. Bardunov in 1962 and V. Ya. Cherdantseva in 1968–1969 and 1974–1975. Their collections cover most of the area of the reserve in its older boundaries (i.e. without the recently added Eastern part). The list compiled based of their studies, complemented by data originated from few additional small collections and publications of Lazarenko includes 233 species (Bardunov & Cherdantseva, 1978). While preparing for the second edition (Bardunov & Cherdantseva, 2006), this list was critically revised, several species were reidentified or excluded due to lack of herbarium specimens, and so only 230 species were included. In September of 2006 M.S. Ignatov and E.A. Ignatova undertook a short field trip in the valley of Komarovka River, and in October of 2008 M.S. Ignatov and V.A. Bakalin collected bryophytes in the vicinity of Anikin Klyuch Field

Station and in the vicinity of Peyshula Field Station, also during few days. Results of identification of mosses were deposited in the database of the moss flora of Russia (Ivanov *et al.*, 2017). Also the specimens from the area were critically revisited in course of taxonomic reviews of several genera in Russia; for instance, only two of four species of the genus *Thamnobryum*, listed by Bardunov & Cherdantseva (2006) were accepted by Ignatova & Ignatov (2011), who added two another species of the genus to the moss flora of the Ussurijsky Reserve.

MATERIALS AND METHODS

The field studies were conducted by VF, YuI and AS since 9th till 25th August 2022 in three areas in the vicinities of Komarovo-Zapovednoe, Anikin Klyuch and Peyshula Field Stations in course of the expedition organized by the Botanical Garden-Institute of the Far East branch of RAS. First area covers Komarovka Creek, middle and upper courses and surrounding watershed areas. The second area includes upper and middle course of Artyomovka River valley, Anikin Klyuch Creek valley and slopes to them. The third area largely includes Zmeinaya Mountain, Koryavaya Pad' Creek valley in lower course and the area around the field station (Fig. 1). In particular, we delivered more attention to the later territory, where several unique records were made by Lazarenko and Ignatov. Since the moss flora of the area was described in details by Bardunov & Cherdantseva (2006) and most of our samples represent already documented records, we extracted from our collections, which count more than 1200 specimens, only those obviously representing species not listed by Bardunov & Cherdantseva (2006). These specimens were processed using the integrative floristic approach (Fedosov *et al.*, 2022c), i.e. employing DNA barcoding to prove the most valuable records. For DNA barcoding we used nuclear ITS region which was obtained according to the protocol, described by Gardiner *et al.* (2005).

RESULTS

The most interesting records are provided below with notes on their ecology and distribution, both within the area and outside it and supplied with original images made from plants from the Ussurijsky State Reserve. More widespread species, which however are new for the re-

serve territory, i.e. not included in the publication of Bardunov & Cherdantseva (2006), are listed mostly only with voucher data or only briefly commented.

Bryum radiculosum Brid. – On the sandy soil, along the bank of the Komarovka River, in the vicinity of the Komarovka Field Station, 11.VIII.2022, Fedosov, Ishchenko & Shkurko (MHA). In Russia this species was reported from West Caucasus and a single locality in Iturup Island (Ignatov *et al.*, 2018; <http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022), so presented is the first report of the species from Primorsky Territory.

Dichodontium pellucidum (Hedw.) Schimp. (Fig. 2A–F) – Koryavaya Pad' Creek near Peyshula Field Station; 18.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). A widespread species, known in the Russian Far East from one locality (Bardunov & Cherdantseva, 1982).

Forsstroemia goughiana (Mitt.) S. Olsson, Enroth & D. Quandt (Fig. 2G–L) – vicinity of Peyshula Field Station, Zmeinaya Mountain southern slope, abundant on shaded limestone rocks of the steep gorge, together with *Homaliadelphus targionianus* or in extensive pure mats, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). Before this species was known in Russia from two localities in the southern part of Primorsky Territory, in the Lozovyj (Chandolaz) Range and in Sestra Mountain (Ignatova *et al.*, 2009; Ignatov *et al.*, 2020), also characterized by extensive calcareous rock outcrops; at the same time, survey of the bryophyte flora of calcareous rock outcrops situated northward, in Kavalerovo and Dalnegorsk Districts, undertaken by V.A. Bakalin, V.E. Fedosov and O. Yu. Pisarenko in 2016 and by V.E. Fedosov and J. Kučera in 2019 do not reveal additional localities of this species.

Glyphomitrium ambiguum Fedosov, Ignatova & Ignatov – vicinity of Komarovo-Zapovednoe Field Station, Grabovaya Mt., on fallen oak trunk and branches, together with *Drummondia sinensis*, 14.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). Before only one species of the genus, *G. humillimum* was reported from the Reserve (Bardunov & Cherdantseva, 2006; Fedosov *et al.*, 2022a), based on two specimens from Zmeinaya Mt., collected by Lazarenko and Ignatov. For a long time only one species of the genus was recognized in Russia until Fedosov *et al.* (2022a) showed that as many as three species of the genus occur there. In course of this study the identification of the specimen from Zmeinaya Mt available in MHA was confirmed, while in course of our field trip in Ussurijsky Reserve two other species, revealed by Fedosov *et al.* (2022a) were collected. *Glyphomitrium ambiguum* largely occurs in the broad-leaved forests of the southern part of Russian Far East, so this species was expected in the area.

G. crispifolium Noguchi – vicinity of Komarovo-Zapovednoe Field Station, on barks of trees: on willow, Field Station, 09.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA); slope Grabovaya Mt., on fallen birch branch, 14.VIII.2022, Fedosov, Ishchenko & Shkurko

(MW). This species is widespread and locally common in humid upper elevations taiga forests of the Sikhote-Alin Range (Fedosov *et al.*, 2022a). Within Sikhote-Alin this species largely occurs at higher elevations than *G. ambiguum*, where mesoclimatic conditions are cooler and more humid. However, within the Ussurijsky Reserve their altitudinal pattern is reversed: *G. crispifolium* occurs in more humid valleys while *G. ambiguum* settle in dryer hill tops, covered by oak (*Quercus mongolica*) dominated forests.

Homaliadelphus targionianus (S. Okamura) Z. Iwats. (Fig. 3A–G) – vicinity of Peyshula Field Station, Zmeinaya Mt. southern and south-eastern slopes, abundant on shaded limestone rocks together with *Forsstroemia goughiana* or in extensive pure mats; the same area, upper part of SE-faced Zmeinaya Mt. slope, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA), Fedosov, Ishchenko & Shkurko, 21.VIII.2022 (MW, MHA). Before this species was found in few other localities in southern part of the Primorsky Territory, in the Lozovyj (Chandolaz) Range, in Sestra Mountain, (Ignatov *et al.*, 2020; (<http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022).

Hyophila involuta (Hook.) A. Jaeger – vicinity of Peyshula Field Station, the lower part of the Zmeinaya Mountain southern slope, abundant on shaded limestone rocks under forest canopy together with *Molendia hornschi* and *Syntrichia cf. sinensis*, Fedosov, Ishchenko & Shkurko, 19.VIII.2022 (MW, MHA). In Russia this species recently appeared to be rather frequent in several areas of the southern part of Primorsky Territory where limestone outcrops occur – in the vicinity of Dalnegorsk Town, Chuguevka Village, in Lozovyj Range, as well as in Transbaikalia, Amur Province (Zeya Nature Reserve) and Shikotan Island (Cherdantseva *et al.*, 2018; Dudov *et al.*, 2018; Ellis *et al.*, 2022).

Ignatovia microphylla (Ignatov & Ignatova) U.B. Deshmukh (Fig. 3H–M) – vicinity of Peyshula Field Station, Zmeinaya Mountain southern slope, on shaded limestone rocks in the steep gorge, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). This species was collected in several places in shaded rocks and boulders. These records are especially interesting since the species was previously known only from a type locality in the Lozovyj (Chandolaz) Range, also from shaded limestones (Ignatov *et al.*, 2019). According to the molecular phylogenetic data presented by Ignatov *et al.* (2019) and to unpublished data by Fedosov *et al.*, this species occupies an isolated position within Leskeaceae. The ITS sequence, obtained from the newly found specimen from Zmeinaya Mt. (OQ085094) is identical to the one, obtained from holotype, thus confirming our identification and a new locality of this poorly known species in Russian Far East.

Miyabea fruticella (Mitt.) Broth. (Fig. 4A–F) – vicinity of Peyshula Field Station, Zmeinaya Mountain southern slope, on limestone rock in the steep gorge, in pure mat, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW,

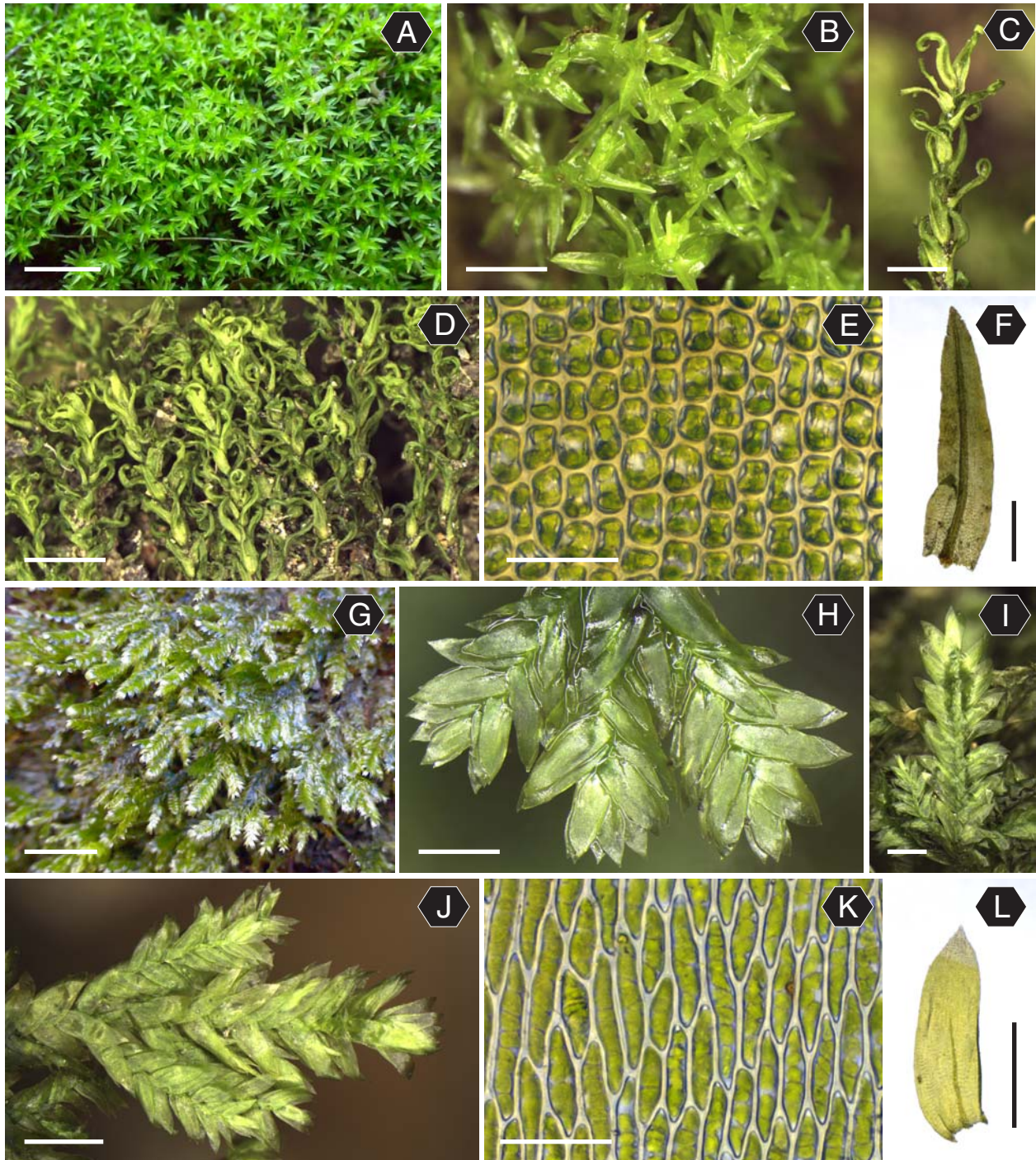


Fig. 2. Mosses of the Ussurijsky State Reserve, A–F: *Dichodontium pellucidum* and G–L: *Forsstroemia goughiana*. A, G: habit in nature; B, H: habit, wet; C–D, I–J: habit, dry; E, K: median laminal cells; F, L: leaves. Scale bars: A: 10 mm; B, D, J: 2 mm; C, H–I: 1 mm; E, K: 30 µm; F, L: 0.5 mm.

MHA). In Russia this species was previously known from Kedrovaya Pad' State Reserve, Lozovyy (Chandolaz) Range, Okeansky Range (<http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022). However, from the vicinity of Peyshula field station of Ussurijsky reserve another species of the genus, *M. rotundifolia* Cardot was reported (Lazarenko, 1941b), and later based on this record also by Bardunov & Cherdantseva (1982) and Cherdantseva *et*

al. (2018), although the authors of the latter paper considered this record as dubious. In course of the moss flora of Russia preparation (Ignatov *et al.*, 2020) M.S. Ignatov (pers. comm.) also studied the specimen collected by Lazarenko in Zmeinaya Mt. and found no difference from *M. fruticella*, so only one species of the genus was included in the moss flora of Russia. Our specimen also clearly fits *M. fruticella* in having dentate upper leaf portion.

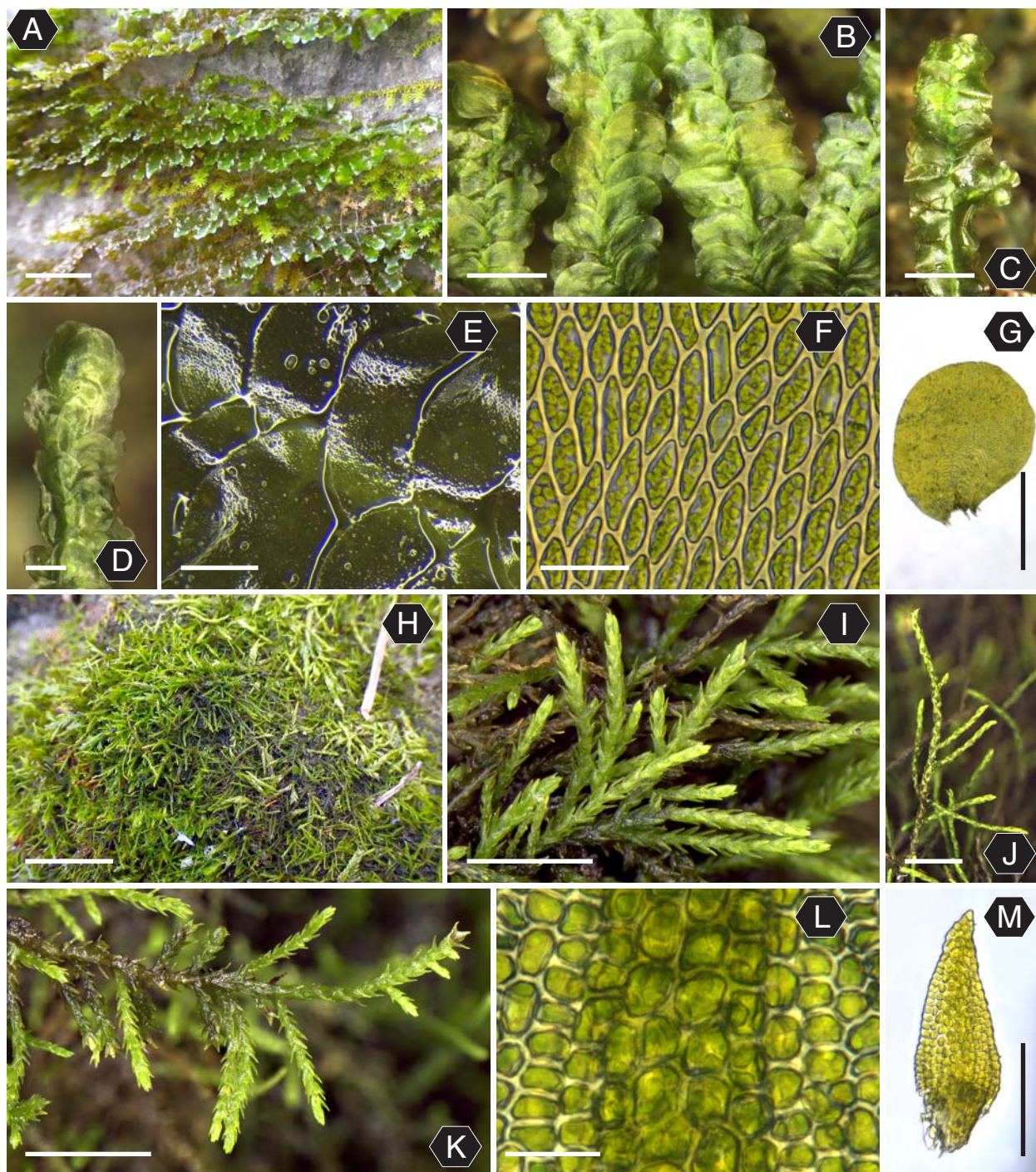


Fig. 3. Mosses of the Ussurijsky State Reserve. A–G: *Homaliadelphus targionianus*; H–M: *Ignatovia microphylla*; Scale bars: A, H: habit in nature; B, I, J: habit, dry; C–E, E: habit, wet; F, L: median laminal cells; G, M: leaves. Scale bars: A: 10 mm; B, I–K: 1 mm; C: 2 mm; D, G: 0.5 mm; E: 300 μ m; F: 30 μ m; H: 8 mm; L: 20 μ m; M: 100 μ m.

Oxyrrhynchium vagans (A. Jaeger) Ignatov & Huttunen – On the soil slope, in the floodplain of the Anikin Klyuch River, 23.VIII.2022, Fedosov, Ishchenko & Shkurko (MHA). This record, considered in more details by Ignatov *et al.* (2022b), provides first evidence of occurrence of this predominantly subtropical Asian species in Russia.

Pararhexophyllum sollmanianum (J.A. Jiménez, M.J. Cano & Shevock) Jan Kučera (Fig. 4G–L) – vicinity of Komarovo-Zapovednoe Field Station, 9.VIII.2022,

Fedosov, Ishchenko & Shkurko (MHA). This Central Asian species was first revealed in Russia by Kučera *et al.* (2020) based on specimens from Transbaikalia and Buryatia; outside Russia the species occurs in the Qinghai and Yunnan provinces of China, so our record is the easternmost one and first for the Primorsky Territory of Russia.

Pseudohygrohypnum orientale Fedosov & Ignatova – vicinity of Komarovo-Zapovednoe Field Station, on wet boulder in creek, 12.VIII.2022, Fedosov, Ishchenko &



Fig. 4. Mosses of the Ussurijsky State Reserve, A-F: *Miyabea fruticella* and G-L: *Pararhexophyllum sollmanianum*. A, G: habit in nature; B, H: habit, wrt; C–D, I–J: habit, dry; E, K: median laminal cells; F, L: leaves. Scale bars: A, G: 8 mm; B, D: 2 mm; C, H, I: 1mm; E, K: 30 μ m; F: 0.3 mm; J, L: 0.5 mm.

Shkurko (MW, MHA). This species was recently described based on specimens from Primorsky Territory, Shikotan Island and Japan (Fedosov *et al.*, 2022b). In Primorsky Territory localities of the species are mostly concentrated north-eastwards of Ussurijsky Reserve, in humid middle elevations of Sikote-Alin mountains (Olkhovaya Mt., Benevskie waterfalls, Pidam Mt., waterfalls near Milogradovka, *etc.*), although recent revision of collections

in IRK confirmed its occurrence also in Kedrovaya Pad' State Reserve, from where it was reported as *Hygrohypnum eugyrium* by Bardunov & Cherdantseva (1982). A specimen from Mironov Klyuch (Ussurijsky Reserve) kept in LE under the latter name, also represents *P. orientale* (Fedosov *et al.*, 2022b), but Bardunov & Cherdantseva (1982, 2006) did not account this record of "*Hygrohypnum eugyrium*".

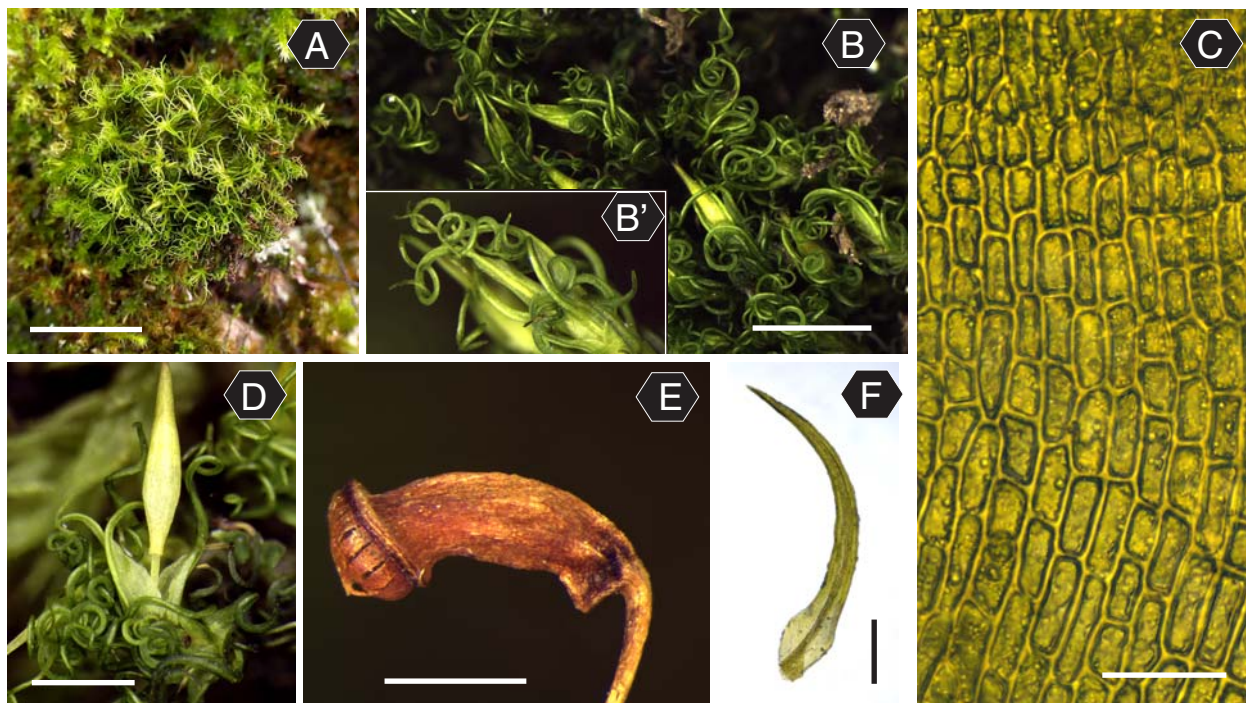


Fig. 6. Mosses of the Ussurijsky State Reserve, A–F: *Symblepharis crispifolia*. A: habit in nature; B, B', D: habit, dry; C: basal and median laminal cells; E: capsule, F: leaf. Scale bars: A: 10 mm; B: 2 mm; C: 50 μ m; D: 1 mm; E, F: 0.5 mm.

Symblepharis crispifolia (Mitt.) Fedosov, M. Stech & Ignatov (Fig. 5A–F) – vicinity of Peyshula Field Station, the western non-calcareous part of Zmeinaya Mt. opposite the field Station, on dry rocks with *Rhabdoweisia crispata* and *Hedwigia emodica*, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). The ITS sequence, obtained from the newly found specimen from Zmeinaya Mt. (OQ085093) is identical to the GenBank sequence LT576470, originated from the specimen from Japan (Hedenäs, 2017). This species (as *Oncophorus crispifolius* Mitt.) was reported from several areas of Russia, but in most cases based on specimens, which actually represented *Symblepharis elongata* s.l., so until present *S. crispifolia* remained known from Russia from a single specimen, collected by A.S. Lazarenko in Hualaza Mt. (southern part of Primorsky Territory) in 1933, identification of this specimen was confirmed by O.M. Afonina (pers. comm.). Present report confirms growth of this rare moss in Russia.

Syntrichia amphidiacea (Müll. Hal.) R.H. Zander – vicinity of Peyshula Field Station, the western non-calcareous part of Zmeinaya Mt. opposite the field Station, in shady cliff crevice, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). In Russia this species is known from several scattered localities in south Siberia and southern part of Russian Far East (Afonina & Ignatova, 2009; Fedosov *et al.*, 2022c; <http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022). In Primorsky Territory it was previously found in the Lozovyj (Chandolaz) Range and in Sinyaya Mt. summit area (Afonina & Ignatova, 2009; Fedosov & Pisarenko, MW9114346).

Ulota japonica (Sull. & Lesq.) Mitt. – vicinity of Anikin Klyuch Field Station, upper course of the Artyomovka River eastwards the Shtykovo-Ivanovka Federal road, slope of the valley, on fallen trunk, 23.VIII.2022, Fedosov, Ishchenko & Shkurko (MW); according to the database of Moss flora of Russia (<http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022), this species was also collected by Ignatov in the valley of Anikin Klyuch Creek, identification of the specimen was confirmed by Fedosov & Ignatova (2018). According to Fedosov & Ignatova (2018), this species is not rare in the Primorsky Territory, both, in Sikhote-Alin and more xeric areas southward.

Weissia longifolia Mitt. – on the edge of mowed meadow around the Peyshula Field Station on bare patches of loamy soil along with *Amblystegium serpens*, 18.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). This species is rather frequent in steppe zone of European Russia, beyond the Ural Mts it is known only from three localities, in Novosibirsk Province, Altaysky Territory and in south part of Primorsky Territory, Lozovyj (Chandolaz) Range (Ignatov *et al.*, 2013; <http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022).

Several less interesting findings, which however are new for the area of the reserve, are considered below:

Barbula unguiculata Hedw. – in the mowed meadow around the Anikin Klyuch Field station and on disturbed soil around buildings along with *Weissia* spp., *Streblotrichum convolutum*, *Physcomitrium eurystomum*, 17.VIII.2022, Fedosov, Ishchenko & Shkurko (MW).



Fig. 6. Mosses of the Ussurijsky State Reserve, all photos *in situ*: A: *Coscinodon* cf. *cribrosus*; B: *Hyophila involuta*; C: *Pseudohygrohypnum orientale*; D: *Weissia longifolia*; E: *Rhynchostegium aquaticum*; F: *Oxyrrhynchium vagans*; G: *Bryonoguchia molkenboeri*; H: *Hypopterygium flavolimbatum*; I: *Drummondia sinensis*; J: *Oticodium laeisetum*.

Coscinodon cribrosus (Hedw.) Spruce (?) – vicinity of Peyshula Field Station, the western non-calcareous part of Zmeinaya Mt. opposite the Field Station, on exposed dry rock, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). The plants were without sporophytes, with strongly plicate distal leaf portion. Unlike *C. hartzii*, another species widespread in Russian Far East, which we have collected only on strongly ferriferous rocks, *C. cribrosus* occasionally occurs on rock with iron content,

which is not obviously high according to the rock colour (typically, in such cases it occurs without sporophytes), as was the case of our plants.

Entodon luridus (Griff.) A. Jaeger – Komarovka River, on partly submerged boulders, 14.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). This species occurs on boulders in streams throughout southern part of Primorsky Territory (Ignatov *et al.*, 2020).

Hygroamblystegium humile (P. Beauv.) Vanderp., Hedenäs & Goffinet – Wet roadside ditch, on loamy soil, 12.VIII.2022, Fedosov, Ishchenko & Shkurko (MW).

Nyholmiella obtusifolia (Brid.) Holmen & E. Warncke – vicinity of Komarovo-Zapovednoe Field Station, Grabovaya Mt., on fallen oak branch, 14.VIII.2022, Fedosov, Ishchenko & Shkurko (MW). This widespread species is however rare in the southern part of Primorsky Territory, where few records of the species in Lazovsky and Shkotovsky Distr. and in the vicinity of Khanka Lake are known (Bardunov & Cherdantseva, 1982; <http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022).

Philonotis fontana (Hedw.) Brid. – boreal forest near the pass between Artyomovka and Komarovka River valleys, on road, 17.VIII.2022, Fedosov, Ishchenko & Shkurko (MW). Although this species is not rare throughout the southern part of Russian Far East, no records from the Ussurijsky Reserve have ever been presented.

Physcomitrium eurystomum Sendtn. – mowed meadow around the Anikin Klyuch Field Station and on disturbed soil around buildings, Fedosov, Ishchenko & Shkurko, 16.VIII.2022 (MW, MHA). Same ecotope in the vicinity of Peyshula Field Station, 17.VIII.2022, Fedosov, Ishchenko & Shkurko (MW). This species is rather widespread and frequent in south Siberia and southern part of Russian Far East, so this record is expected.

Pohlia nutans (Hedw.) Lindb. – boreal forest near the pass between Artyomovka and Komarovka River valleys, on stump, 17.VIII.2022, Fedosov, Ishchenko & Shkurko (MW). This species is common nearly throughout Russia excepting areas with xeric climates; however, in southern part of Primorsky Territory, especially in a rather dry climate of low mountains around Vladivostok it is rare that may explain the fact that it was not included in the list of species of Ussurijsky Reserve by Bardunov & Cherdantseva (2006).

Rhabdoweisia crispata (Dicks.) Lindb. – vicinity of Peyshula Field Station, the western non-calcareous part of Zmeinaya Mt. opposite the Field Station, on dry rock with *Symblepharis crispifolia*, 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA).

Schistidium sibiricum Ignatova & H.H. Blom – Semi-flooded boulders washed by the current of the Komarovka River, on the bank along with *Entodon luridus*, 13.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). This recently described species is common in the Russian Far East, including the Primorsky Territory (Ignatov *et al.*, 2017; <http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022), but has not been previously recorded for the Ussurijsky Reserve.

DISCUSSION

In addition to the previously unknown from the area moss species, several species underwent taxonomic changes. Below we consider several cases, not however pretending to cover them all.

Forsstroemia producta (Hornsch.) Paris – This species was actually revealed in the area of Ussurijsky Reserve already by Lazarenko (1941a), who described it under the name *Forsstroemia stricta* Laz. from the vicinity of Peishula Field Station. This species was generally accepted (Ignatov *et al.*, 2006; Cherdantseva *et al.*, 2018, *etc.*) until Enroth *et al.* (2019) showed that it does not differ from the widely distributed *Forsstroemia producta*. This species is not rare in the Reserve, Ignatov collected it in the upper course of Artyomovka River, (<http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022) and we found it in several places in the vicinity of Peyshula Field Station and in the valley of Komarovka River.

Hedwigia emodica Hampe ex Müll. Hal. was collected on dry rocks, where it grew with *Abietinella abietina* (Hedw.) M. Fleisch., 14.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA) and in similar environments with *Rhytidium rugosum* (Hedw.) Kindb., 20.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). This species was also noticed to occur in Ussurijsky Reserve by Ignatova *et al.* (2016). According to the recent taxonomic study of the genus *Hedwigia* in Russia, *H. ciliata* (Hedw.) P. Beauv. occurs mostly in NW and central parts of European Russia, while all records from the Far East should be referred to the other species, including records of Bardunov & Cherdantseva (2006) from the Ussurijsky Reserve.

Rhynchostegium aquaticum A. Jaeger – vicinity of Peyshula Field Station, on boulder in Koryvaya Pad' Creek, 18.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA); vicinity of Komarovo-Zapovednoe Field Station, on wet boulder in creek, 12.VIII.2022, Fedosov, Ishchenko & Shkurko (MW, MHA). Within the studied area the species does not occur in Rivers with slower water (Artyomovka, Komarovka) but is rather frequent in the Koruavaya Pad' with clean and fast water. Probably, this species was collected in Ussurijsky Reserve by Cherdantseva as well, but referred to *Platyhypnidium riparioides* (Hedw.) Dixon (= *Rhynchostegium riparioides* (Hedw.) Cardot), the species which does not occur in Primorsky Territory according to Huttunen & Ignatov (2010).

Moreover, the amount of changes in taxonomy of mosses led to need in reexamination of herbarium material, representing several groups, which from the current point of view could not be identified correctly by Bardunov & Cherdantseva (2006). Probably, the most bright example of such changes represents the genus *Schistidium* Hedw., which is represented by three species in the list by Bardunov & Cherdantseva (2006), while in the database of the moss flora of Russia (<http://arctoa.ru/Flora/basa.php>, accessed 21 December 2022) another three species are recorded. Likewise, several species, reported from the area earlier, such as *Lewinskya speciosa* (Nees) F. Lara, Garilleti & Goffinet (= *Orthotrichum speciosum*

Nees), probably do not occur in its territory at all (Ignatov *et al.*, 2018). Then, widespread on rotten logs *Symblypharis elongata* (I. Hagen) Fedosov, M. Stech & Ignatov could not be omitted by Bardunov and Cherdantseva, but in their list it is referred to as *Oncophorus wahlenbergii* Brid., the species, which until recently has been considered much wider, than recent molecular phylogenetic studies (Hedenäs, 2017) suggested.

Revisions of several groups are still in process. In particular, this is the case of the family Lekseaceae s.l., especially of the genera *Haplocladium* (Müll. Hal.) Müll. Hal. and *Elodium* (Sull.) Austin ex C.F. Parker, which are widespread and common in the area (results of this ongoing revision are partly disclosed in Ignatov *et al.*, 2022). The same is true for East Asian Orthotrichaceae, which remain scarcely explored with the integrative taxonomic approach.

Although southern part of Primorsky Territory for a long time has attracted attention of Soviet and Russian bryologists and is rather densely sampled comparing with many other regions of Russia, floristic studies in this areas have not yielded well elaborated local bryophyte floras with an exception of the Muravjov-Amurskiy' Peninsula (Gorobets, 2004). Despite from the previous discussion follows that a lot remains to be done before the bryophyte flora of Ussurijsky Reserve could be considered indeed well studied, at the moment it represents probably the best studied one in the southern part of Primorsky Territory. Within it, Zmeinaya Mountain represents the remarkable hot spot, where many rare mosses including those, listed in the red data book of Russia occur.

ACKNOWLEDGEMENTS

Authors are grateful to the administration of Botanical Garden-Institute and administration of Zemlya Leoparda National Park for organizing the field trip and to M.S. Ignatov and E.A. Ignatova for help in the manuscript preparation. The work of V. Fedosov was performed within the frameworks of the Interdisciplinary Scientific and Educational School of M.V. Lomonosov Moscow State University "The future of the planet and global environmental change" and was supported by the RSF grant # 18-14-00121-П. A. Shkurko, A. Fedorova and O. Kuznetsova acknowledge the support from the Tsitsin Main Botanical Garden state assignments no. 122042700002-6 (AS) and 122020300187-2 (OK and AF). We also thank the Ministry of Higher Education and Science of the Russian Federation for support and the Center of Collective Use "Herbarium MBG RAS" (grant 075-15-2021-678).

LITERATURE CITED

- [AFONINA, O.M. & E.A. IGNATOVA] АФОНИНА О.М., Е.А. ИГНАТОВА. 2009. *Syntrichia amphidiacea* (Pottiaceae) – новый вид для флоры мхов России. – [*Syntrichia amphidiacea* (Pottiaceae), a new species for the moss flora of Russia] *Ботанический журнал [Botanicheskii Zhurnal]* **94**(3): 439–443.
- [AZBUKINA, Z.M., L.V. BARDUNOV, T.A. BEZDELEVA, A.V. BOGACHEVA, E.M. BULAKH, L.N. VASILJEVA, O.K. GOVOROVA, E.GOROVA O.K., E.V. ZHABIYAKO, T.V. NIKULINA, I.M. RODNIKOVA, I.F. SKIRINA, V.I. TARANKOV, L.A. FEDINA & V.YA. CHERDANTSEVA] АЗБУКИНА З.М., Л.В. БАРДУНОВ, Т.А. БЕЗДЕЛЕВА, А.В. БОГАЧЕВА, Е.М. БУЛАХ, Л.Н. ВАСИЛЬЕВА, О.К. ГОВОРОВА, О.К. ЕГОРОВА, Е.В. ЖАБЫКО, Т.В. НИКУЛИНА, И.М. РОДНИКОВА, И.Ф. СКИРИНА, В.И. ТАРАНКОВ, Л.А. ФЕДИНА, В.Я. ЧЕРДАНЦЕВА. 2006. Флора, растительность и микобиота заповедника "Уссурийский". – [Flora, vegetation and mycobiota of the reserve "Ussurijsky"] *Владивосток, Дальнаука [Vladivostok, Dal'nauka]*, 300 pp.
- [BARDUNOV, L.V. & V.YA. CHERDANTSEVA] БАРДУНОВ Л.В., В.Я. ЧЕРДАНЦЕВА. 1978. Мохообразные. – [Bryophytes] *В кн.: Флора и растительность Уссурийского заповедника, ред. Харкевич С.С. [In: Kharkevich, S.S. (ed.) Flora and vegetation of the Ussurijsky Reserve] М., Наука [Moscow, Nauka]: 127–148.*
- [BARDUNOV, L.V. & V.YA. CHERDANTSEVA] БАРДУНОВ Л.В., В.Я. ЧЕРДАНЦЕВА. 1982. Листостебельные мхи Южного Приморья. – [Mosses of the South of Primorskiy Province] *Новосибирск, Наука [Novosibirsk, Nauka]*, 208 pp.
- [BARDUNOV, L.V. & V.YA. CHERDANTSEVA] БАРДУНОВ Л.В., В.Я. ЧЕРДАНЦЕВА. 2006. Мохообразные. – [Bryophytes] *В кн.: Флора, растительность и микобиота заповедника "Уссурийский" (ред. Л.Н. Васильева) Владивосток, изд-во Дальнаука [In: Vasilyeva, L.N. (ed.) Flora, rastite l'nost' i micobiota zapovednika "Ussurijsky". Vladivostok, Dal'nauka]: 51–78.*
- CHERDANTSEVA, V.YA., O.YU. PISARENKO, M.S. IGNATOV, E.A. IGNATOVA, V.E. FEDOSOV, S.V. DUDOV & V.A. BAKALIN. 2018. Mosses of the southern Russian Far East, an annotated check-list. – *Botanica Pacifica* **7**(2): 53–81. <http://dx.doi.org/10.17581/bp.2018.07206>
- DUDOV, S.V., M.N. KOZHIN, V.E. FEDOSOV, E.A. IGNATOVA & M.S. IGNATOV. 2018. Moss flora of Zeysky State Nature Reserve (Turingra Range, Amur Province, Russia). – *Botanica Pacifica* **7**(2): 83–104. <http://dx.doi.org/10.17581/bp.2018.07204>
- ELLIS, L.T., C. ARROCHA, Á. BENÍTEZ, M. BEYROUTHY, V.K. CHANDINI, I.V. CZERNYADJEVA, J. DEME, P. ERZBERGER, V.E. FEDOSOV, P. GÓRSKI, J. GUERRA, V. HUGONNOT, T. LAUTENSCHLÄGER, G.E. LEE, P. MAIR, YU.S. MAMONTOV, C.N. MANJU, K.M. MANJULA, A. MESTERHÁZY, B. MUFEED, F. MÜLLER, C. NEINHUIS, C. NÉMETH, R.R. PAUL, T. PÓCS, R.D. PORLEY, K.P. RAJESH, F. RAOUF FARD, K.K. RAWAT, E. RODRÍGUEZ-QUIEL, A. SCHÄFER-VERWIMP, S. STEFĀNUȚ, W. TRATTER, I. VERWIMP, A.A. VILNET, I.M. WOLF & R.H. ZANDER. 2022. New national and regional bryophyte records, 71. *Published online 21 Nov 2022*. <http://doi.org/10.1080/03736687.2022.2143223>
- ENROTH, J., V.E. FEDOSOV, A.V. FEDOROVA, E.A. IGNATOVA & M.S. IGNATOV. 2019. Miscellaneous notes on the genus *Forsstroemia* in Russia (Neckeraceae, Bryophyta). – *Arctoa* **28**: 18–23. <https://doi.org/10.15298/arctoa.28.03>
- FEDOSOV, V.E. & E.A. IGNATOVA. 2018. On the genus *Ulota* (Orthotrichaceae, Bryophyta) in Russia. – *Novosti sistematiki nizshikh rastenii* **52**(1): 141–171. <https://doi.org/10.31111/nsnr/2018.52.1.141>
- FEDOSOV, V.E., E.A. IGNATOVA, A.V. SHKURKO, A.V. FEDOROVA & M.S. IGNATOV. 2022a. A review of the genus *Glyphomitrium* (Rhabdoweisiaceae, Bryophyta) in Russian Far East. – *Journal of Bryology. Published online 22 Oct 2022*. <https://doi.org/10.1080/03736687.2022.2126097>
- FEDOSOV, V.E., A.V. SHKURKO, A.V. FEDOROVA, E.A. IGNATOVA, E.N. SOLOVYEVA, J.C. BRINDA, M.S. IGNATOV & J. KUČERA. 2022b. Need for split: integrative taxonomy reveals unnoticed diversity in subaquatic species of *Pseudohygrohypnum* (Pylaisiaceae, Bryophyta). – *PeerJ*. **10**: e13260 <https://doi.org/10.7717/peerj.13260>
- FEDOSOV, V.E., O.M. AFONINA, M.S. IGNATOV, E.A. IGNATOVA, S.G. KAZANOVSKY, O.I. KUZNETSOVA, YU.S. MAMONTOV, N.A. KONSTANTINOVA, D.E. KOLTYSHEVA, S. KUBEŠOVÁ, M.P. LAMKOWSKI, A. MANUKJANOVÁ, N.S. GAMOVA, A.V. FEDOROVA, S.V. DUDOV, A.V. VERKHOZINA & J. KUČERA.

- 2022c. Integrative Floristics – a modern approach to biodiversity surveys in molecular era at the example of expedition to Khamar-Daban Range (Southern Siberia, Russia). – *Journal of Bryology*. **44** (2): 1–27. <https://doi.org/10.1080/03736687.2022.2078767>
- GARDINER, A., M. IGNATOV, S. HUTTUNEN & A. TROITSKY. 2005. On resurrection of the families Pseudoleskeaceae Schimp. and Pylaisiaceae Schimp. (Musci, Hypnales). – *Taxon* **54**: 651–663. <https://doi.org/10.2307/25065422>
- [GOROBETS, K.V.] ГОРОБЕЦ К.В. 2004. Флора листостебельных мхов п-ова Муравьева-Амурского и островов залива Петра Великого (Приморский край). Автореферат диссертации кандидата биологических наук. Владивосток: ТИБОУ ДВО РАН. – [Moss flora of Murajov-Amursky Peninsula and islands of Petra Velikogo Bay (Primorsky Territory)]. Ph.D. Thesis, Vladivostok, Tikhookeansky Institut Bioorganicheskoy Khimii Dalnevostochnogo Otdeleniya Akademii Nauk], 22 pp.
- HEDENÄS, L. 2017. Scandinavian *Oncophorus* (Bryopsida, Oncophoraceae): species, cryptic species, and intraspecific variation. – *European Journal of Taxonomy* **315**: 1–34. <https://doi.org/10.5852/ejt.2017.315>
- IGNATOV, M.S., O.M. AFONINA, E.A. IGNATOVA, A.A. ABOLINA, T.V. AKATOVA, E.Z. BAISHEVA, L.V. BARDUNOV, O.A. BARYAKINA, O.A. BELKINA, A.G. BEZGODOV, M.A. BOYCHUK, V.YA. CHERDANTSEVA, I.V. CZERNYADJEVA, G.YA. DOROSHINA, A.P. DJACHENKO, V.E. FEDOSOV, I.L. GOLDBERG, E.I. IVANOVA, I. YUKONENE, L. KANNUKENE, S.G. KAZANOVSKY, Z.KH. KHARZINOV, L.E. KURBATOVA, A.I. MAKSIMOV, U.K. MAMATKULOVA, V.A. MANAKYAN, O.M. MASLOVSKY, M.G. NAPREENKO, T.N. OTNYUKOVA, L.YA. PARTYKA, O.YU. PISARENKO, N.N. POPOVA, G.F. RYKOVSKY, D.YA. TUBANOVA, G.V. ZHELEZNOVA & V.I. ZOLOTOV. 2006. Check-list of mosses of East Europe and North Asia. – *Arctoa* **15**: 1–130. <https://doi.org/10.15298/arctoa.15.01>
- IGNATOV, M.S., O.D. DUGAROVA, A.V. FEDOROVA & E.A. IGNATOVA. 2019. *Lazarenkoa* a new moss genus from the Russian Far East. – *Arctoa* **28**(2): 226–230. <https://doi.org/10.15298/arctoa.28.21>
- IGNATOV, M.S. & E.A. IGNATOVA. 2011. The genus *Thamnobryum* (Neckeraceae, Bryophyta) in Russia. – *Arctoa* **20**: 137–151. <https://doi.org/10.15298/arctoa.20.10>
- [IGNATOV, M.S., E.A. IGNATOVA, V.E. FEDOSOV, E.I. IVANOVA, N.H. BLOM, J. MUÑOZ, H. BEDNAREK-OSCHYRA, O.M. AFONINA, L.E. KURBATOVA, I.V. CZERNYADJEVA & V.YA. CHERDANTSEVA. 2017]. ИГНАТОВ М.С., Е.А. ИГНАТОВА, В.Э. ФЕДОСОВ, Е.И. ИВАНОВА, Х.Х. БЛОМ, И. МУНЬОС, Х. БЕДНАРЕК-ОХЫРА, О.М. АФОНИНА, Л.Е. КУРБАТОВА, И.В. ЧЕРНЯДЬЕВА, В.Я. ЧЕРДАНЦЕВА. 2017. Флора мхов России. Том 2. *Oedipodiales – Grimmiales*. – [Moss Flora of Russia. *Oedipodiales – Grimmiales*, Vol.2]. М.: Товарищество научных изданий КМК [Moscow, KMK], 560pp.
- [IGNATOV, M.S., E.A. IGNATOVA, V.E. FEDOSOV, V.I. ZOLOTOV, T. KORONEN, I.V. CZERNYADJEVA, G.YA. DOROSHINA, D.YA. TUBANOVA & N.E. BELL. 2018]. ИГНАТОВ, М.С., Е.А. ИГНАТОВА, В.Э. ФЕДОСОВ, В.И. ЗОЛОТОВ, Т. КОПОНЕН, И.В. ЧЕРНЯДЬЕВА, Г.Я. ДОРОШИНА, Д.Я. ТУБАНОВА, Н.Э. БЕЛЛ. 2018. Флора мхов России. Том 4. *Bartramiales – Aulacomniales*. – [Moss Flora of Russia. Vol. 4. *Bartramiales – Aulacomniales*] М., КМК [Moscow, KMK], 542 pp.
- [IGNATOV, M.S., E.A. IGNATOVA, V.E. FEDOSOV, I.V. CZERNYADJEVA, O.M. AFONINA, A.I. MAKSIMOV, J. KUČERA, T.V. AKATOVA & G.YA. DOROSHINA] ИГНАТОВ М.С., Е.А. ИГНАТОВА, В.Э. ФЕДОСОВ, И.В. ЧЕРНЯДЬЕВА, О.М. АФОНИНА, А.И. МАКСИМОВ, Я. КУЧЕРА, Т.В. АКАТОВА, Г.Я. ДОРОШИНА. 2020. Флора мхов России. Том 5. *Hypopterygiales – Hypnales (Plagiotheciaceae – Brachytheciaceae)*. – [Moss Flora of Russia. Vol.5 *Hypopterygiales – Hypnales (Plagiotheciaceae – Brachytheciaceae)*] М.: КМК [Moscow, KMK Scientific Press], 600 pp.
- [IGNATOV, M.S., E.A. IGNATOVA, V.E. FEDOSOV, O.M. AFONINA, I.V. CZERNYADJEVA, L. HEDENÄS & V.YA. CHERDANTSEVA] ИГНАТОВ М.С., Е.А. ИГНАТОВА, В.Э. ФЕДОСОВ, О.М. АФОНИНА, И.В. ЧЕРНЯДЬЕВА, Л. ХЕДЕНАС, В.Я. ЧЕРДАНЦЕВА. 2022а. Флора мхов России. Том 6. *Hypnales (Calliergonaceae – Amblystegiaceae)*. – [Moss Flora of Russia. Vol.6. *Hypnales (Calliergonaceae – Amblystegiaceae)*.] М.: КМК [Moscow, KMK Scientific Press], 472 pp.
- IGNATOV, M.S., E.A. IGNATOVA & E.V. MALASHKINA. 2013. *Ephemerum spinulosum* Bruch & Schimp. (Bryophyta) – a new species for Russia. – *Arctoa* **22**: 97–100. <https://doi.org/10.15298/arctoa.22.14>
- IGNATOV, M.S., Y.S. ISHCHEENKO & O.I. KUZNETSOVA. 2022. New data on the genus *Oxyrrhynchium* (Brachytheciaceae, Bryophyta) in the Russian Far East. – *Arctoa* **28**: 128–136. <https://doi.org/10.15298/arctoa.28.14>
- IGNATOVA, E.A., M.S. IGNATOV & V.YA. CHERDANTSEVA. 2009. The genus *Neckera* (Neckeraceae, Bryophyta) in the Russian Far East. – *Arctoa* **18**: 177–188. <https://doi.org/10.15298/arctoa.18.11>
- IGNATOVA, E.A., O.I. KUZNETSOVA, V.E. FEDOSOV & M.S. IGNATOV. 2016. On the genus *Hedwigia* (Hedwigiaceae, Bryophyta) in Russia. – *Arctoa* **25**(2): 241–277. <https://doi.org/10.15298/arctoa.25.20>
- IVANOV, O.V., M.A. KOLESNIKOVA, T.V. AKATOVA, O.M. AFONINA, E.Z. BAISHEVA, A.G. BEZGODOV, O.A. BELKINA, I.V. CZERNYADJEVA, S.V. DUDOV, V.E. FEDOSOV, E.A. IGNATOVA, E.I. IVANOVA, M.N. KOZHIN, E.D. LAPSHINA, A.A. NOTOV, O.YU. PISARENKO, N.N. POPOVA, A.N. SAVCHENKO, V.V. TELEGANOVA, D.YA. UKRAINSKAYA & M.S. IGNATOV. 2017. The database of the moss flora of Russia. – *Arctoa* **26**(1): 1–10. <https://doi.org/10.15298/arctoa.26.01>
- KUČERA, J., P. SOLLMAN, O.M. AFONINA, E.A. IGNATOVA, V.E. FEDOSOV, J.R. SHEVOCK, D.YA. TUBANOVA & M.S. IGNATOV. 2020. Range extensions for *Bryoerythrophyllum sollmanianum* and *Tortula yuennanensis* (Pottiaceae, Musci) with reconsideration of their phylogenetic affinities including *Pararhexophyllum*, gen. nov. – *Nova Hedwigia* **150**: 273–292. <http://dx.doi.org/10.1127/nova-suppl/2020/273>
- [LAZARENKO, A.S.] ЛАЗАРЕНКО А.С. 1936. Краткий определитель листовых мхов Дальнего Востока. – [Brief handbook of mosses of Far East] Владивосток, ДВО АН СССР [Vladivostok, Dalnevostochnoe Otdelenie Akademii Nauk SSSR], 101 pp.
- [LAZARENKO, A.S.] ЛАЗАРЕНКО А.С. 1940. Листяні мохи Радянського Далекого Сходу I. Верхоплідні мохи (Acrocarpaе: Andreaeales-Schistostegiales). – [Leafy mosses of the Soviet Far East. I (Acrocarpaе: Andreaeales-Schistostegiales)] *Ботанический журнал АН УРСР [Botanicheskii Zhurnal Akademii Nauk Ukrainskoi RSR]* **1**(3–4): 239–243.
- [LAZARENKO, A.S.] ЛАЗАРЕНКО А.С. 1941а. Листяні мохи Радянського Далекого Сходу II. Acrocarpaе: Orthotrichales-Eubryales; Pleurocarpaе: Isobryales–Hypnobryales (Theliaceae-Leskeaceae). – [Leafy mosses of the Soviet Far East. II. Acrocarpaе: Orthotrichales-Eubryales; Pleurocarpaе: Isobryales–Hypnobryales (Theliaceae-Leskeaceae)] *Ботанический журнал АН УРСР [Botanicheskii Zhurnal Akademii Nauk Ukrainskoi RSR]* **2**(1): 51–95.
- [LAZARENKO, A.S.] ЛАЗАРЕНКО А.С. 1941b. Листяні мохи Радянського Далекого Сходу III. Thuidiaceae-Brachytheciaceae. – [Leafy mosses of the Soviet Far East. III. Thuidiaceae-Brachytheciaceae] *Ботанический журнал АН УРСР [Botanicheskii Zhurnal Akademii Nauk Ukrainskoi RSR]* **2**(2): 271–308.
- [LAZARENKO, A.S.] ЛАЗАРЕНКО А.С. 1945. Листяні мохи Радянського Далекого Сходу IV. Entodontaceae-Hylocomiaceae. – [Leafy mosses of the Soviet Far East. IV. Entodontaceae – Hylocomiaceae] *Ботанический журнал АН УРСР [Botanicheskii Zhurnal Akademii Nauk Ukrainskoi RSR]* **2**(3–4): 185–216.
- [SAVICZ, L.I.] Савич Л.И. 1923. Список мхов Южно-Уссурийского края. – [List of mosses of the South Ussuri Krai] *Труды Главного Ботанического Сада [Trudy Glavnogo Botanicheskogo Sada]* **39**: 3–31.