Nine *Micarea* species new to Canada including five species new to North America

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Abstract: Konoreva, L. A., Chesnokov, S. V., Stepanchikova, I. S., Spribille, T., Björk, C. & Williston, P. 2021. Nine *Micarea* species new to Canada including five species new to North America. – Herzogia **34**: 18–37.

Nine species of the genus *Micarea* are reported for the first time from Canada including five (*M. contexta*, *M. fallax*, *M. pseudomicrococca*, *M. pusilla*, *M. tomentosa*) which are new to North America. Most of them are part of the *Micarea prasina* complex. Canadian records of further rare or taxonomically challenging species (*M. botryoides*, *M. inopinula, M. prasina* s. str.) are revised. The Canadian records are discussed in the context of their wider distribution, and differences to related or morphologically similar species are indicated.

Zusammenfassung: Konoreva, L. A., Chesnokov, S. V., Stepanchikova, I. S., Spribille, T., Björk, C. & Williston, P. 2021. Nine *Micarea* species new to Canada including five species new to North America. – Herzogia **34**: 18–37.

Neun Arten der Gattung *Micarea* werden erstmals für Kanada gemeldet, davon fünf (*M. contexta*, *M. fallax*, *M. pseudomicrococca*, *M. pusilla*, *M. tomentosa*) neu für Nordamerika. Die meisten dieser Arten sind Teil des *Micarea prasina*-Komplex. Kanadische Funde weiterer seltener oder taxonomisch problematischer Arten (*M. botryoides*, *M. inopinula, M. prasina* s. str.) werden revidiert. Die Vorkommen dieser Arten in Kanada werden im Zusammenhang ihrer weiteren Verbreitung diskutiert und Unterschiede zu verwandten und morphologisch ähnlichen Arten aufgezeigt.

Key words: Biogeography, British Columbia, Pacific Northwest, Pilocarpaceae, taxonomy.

Introduction

A significant number of papers have contributed to the knowledge of the distribution of the genus *Micarea* Fr. and related genera in North America (Barton & Lendemer 2014, Coppins & May 2001, Coppins & Spribille 2004, Coppins & Tønsberg 2001, Eversman et al. 2002, Fryday 2006, 2017, Fryday & Coppins 2007, Launis & Myllys 2014, McCarthy et al. 2015, McCune 2017, McCune et al. 2014, Spribille et al. 2010, Tønsberg & Coppins 2000, etc.). In the most recent version of the lichen checklist of the Continental United States and Canada (Esslinger 2019), a large list of micareoid lichens is presented, including 43 species from the genus *Micarea* and four from the genus *Brianaria* S.Ekman & M.Svensson. *Micarea soralifera* Guzow-Krzem. et al., which ist reported by Lenclemer for Indiana (Lendemer 2017), ist not listed in Esslinger's checklist. Three additional species are reported as new to North America by Spribille et al. (2020). However, *Micarea* s. lat. still remains insufficiently studied in North America, given the vast territory and wide variety of habitats. A significant num-

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ber of taxonomic papers on the taxonomy of *M. prasina* group, with >20 recently described species from extratropical regions (Coppins & Tønsberg 2001, Czarnota 2007, Czarnota & Guzow-Krzemińska 2010, Guzow-Krzemińska et al. 2016, 2019, Launis et al. 2019a, b, Launis & Myllys 2019, van den Boom et al. 2017, 2020, van den Boom & Coppins 2001) inspired us to explore this group in western Canada. In this paper we present the first results of our studies on the genus *Micarea* in northwestern Canada.

Materials and Methods

Field and herbarium studies

This study is based on the field work of Irina Stepanchikova in British Columbia (Canada) in 2018 with specimens deposited in LE as well as on revisions of herbarium material by the first two authors in H, SBBG, DUKE, MOR, MIN, US-L, HAW-L, UBC (Index Herbariorum: http://sweetgum.nybg.org/science/ih/). The material was examined using standard microscopic techniques (Smith et al. 2009). Crystalline granules were investigated by using a compound microscope Micromed 6 and Carl Zeiss Jena NU 2 with polarization filters. High Performance Thin Layer Chromatography (HPTLC) was performed according to standard procedures (Culberson & Ammann 1979, Kranner et al. 2002) at the Laboratory of Lichenology and Bryology of the Komarov Botanical Institute, using solvent system C. The names of pigments observed in *Micarea* species are given according to Meyer & Printzen (2000). Photographs of the species were made using AxioCam MRc5 digital camera mounted on Stemi-2000 CS light microscope. The distribution maps were prepared using MapInfo Professional v. 12.0.2 GIS software (MapInfo Corp., North Greenbush, New York, USA, https://www.precisely.com/).

DNA extraction, PCR amplification and DNA sequencing

DNA was extracted directly from pieces of thalli or apothecia using the modified CTAB method (Guzow-Krzemińska & Węgrzyn 2000) and used for PCR amplification of mtSSU rDNA. The primers mrSSU1 and mrSSU3R (Zoller et al. 1999) were used as PCR and sequencing primers. PCR amplifications were performed with the following programme: initial denaturation at 95 °C for 10 min and six cycles at 95 °C for 1 min, 62 °C for 1 min and 72 °C for 105 s, and then 40 cycles at 95 °C for 1 min, 56 °C for 1 min and 72 °C for 1 min, and a final extension step at 72 °C for 10 min (Czarnota & Guzow-Krzemińska, 2010, with our modification). Amplicons were sequenced by Eurogen (Moscow, Russia, https://evrogen.ru/). Newly generated sequences were deposited in NCBI (GenBank). *Psilolechia lucida* (Ach.) M.Choisy was selected as outgroup based on the phylogenetic reconstruction by Czarnota & Guzow-Krzemińska (2010).

Sequence alignment and phylogenetic analysis

Newly obtained sequences were edited in FinchTV 1.4.0 (Geospiza, Inc.; Seattle, Washington, USA; http://www.geospiza.us) and BioEdit 7.2.5 (Hall 1999). All datasets were aligned online by MAFFT 7 (Katoh & Standley 2013; available at http://mafft.cbrc.jp/alignment/server/) with the L-INS-i method (Katoh et al. 2005) selected automatically by the program for each datasets. Parts of the alignment with ambiguous positions that might not have been homologous and terminal ends were excluded from the analyses. Maximum likelihood reconstruction was carried out in RAxML (Stamatakis et al. 2005) through the RAxMLGUI interface (Silvestro & Michalak 2012). Bootstrap support values were calculated on 1000 bootstrap replicates using rapid bootstrapping ('ML + rapid bootstrap' function in RAxMLGUI). Analyses were run on the CIPRES Web Portal (http://www.phylo.org/portal2/).

Fig. 1. A maximum likelihood (ML) phylogeny of *Micarea laeta*, *M. prasina*, *M. pusilla* and *M. tomentosa* inferred from mtSSU sequences. Bootstrap values ≥ 70 % are indicated by thickened branches. Newly sequenced samples are indicated by bold text.

Results and Discussion

A total of seven new mtSSU rDNA sequences were generated; 104 sequences were downloaded from GenBank. The final alignment consisted of 111 sequences and 1263 characters, of which 920 were parsimony-informative.

The phylogenetic reconstruction (Fig. 1) shows that our sequences of *Micarea laeta*, *M. prasina* s.str., *M. pusilla* and *M. tomentosa* from Canada were placed in well supported clades with other sequences of the same species from European samples. Unfortunately, we were unable to isolate DNA and obtain sequences of *M. contexta*, *M. fallax*, *M. microareolata* and *M. pseudomicrococca*. These species were identified given by anatomical, morphological and chemical characteristics only.

In total twelve species of *Micarea* were identified, including nine species new to Canada, of which five are new to North America. This brings the total number of species in *Micarea* s. lat. in North America to 52.

The examined specimens are listed below. Differences between related species are discussed along with data on our specimens regarding their secondary metabolites, ecology and distribution.

Species new to North America

Micarea contexta Hedl., Bih. K. Svenska Vetensk. Akad. Handl. III. 18(3): 83, 96. 1892. ≡ *Catillaria contexta* (Hedl.) Zahlbr, Cat. Lich. univ. 4: 35 (1926) (Fig. 2E).

Type: Sweden, Hälsingland, Ovanaker, 1891, J. T. Hedlund (lectotype: S).

Description of studied specimens: Thallus endoxylic, inconspicuous. Photobiont micareoid, up to 7 µm in diam. Apothecia black, small, 0.1–0.2 mm, immarginate even when young. Epihymenium dark green, hymenium ±hyaline or dilute greenish with dark green vertical streaks 40–45 µm tall, hypothecium purple-brown to black, up to 75 µm tall. Ascospores 1-septate, ovoid, upper cell slightly wider than lower, in our material 7–10 × (2.5)3–4 µm. Crystalline granules are absent in the thallus and apothecia.

Chemistry: No substances detected by HPTLC. Hymenium and epihymenium K ± green intensifying, N+ red to purplish, HCl+ blue-green (Cinereorufa-green pigment); hypothecium K+ green, N+ red, HCl+ purple (Melaena-red pigment).

Note: *Micarea contexta* is similar to *M. nigella* Coppins, *M. deminuta* Coppins and immature forms of *M. melaena* (Nyl.) Hedl., but differs from these species by 1-septate spores. In addition *M. nigella* has simple spores and stalked pycnidia (Czarnota 2011, Smith et al. 2009) and *M. deminuta* differs in simple ascospores, olivaceous brown epihymenium (K– or K+ olivaceous) and red-brown hypothecium (K± dulling) (Coppins 1995, Czarnota 2007, Smith et al. 2009)

Ecology and Distribution: This species prefers deadwood in old coniferous forests. World distribution: Europe – Sweden (Coppins 1983), Czech Republic (Palice 1999), Switzerland (Groner 2006), Scotland (Smith et al. 2009), Poland (Czarnota 2011), Norway (Holien et al. 2016), Finland (Myllys & Launis 2018), European Russia (Fadeeva et al. 2007, Hermansson et al. 2006, Himelbrant et al. 2018, Stepanchikova et al. 2020, Tarasova et al. 2020), Asia – Russian Far East (Konoreva et al. 2019) and Australia (Kantvilas & Coppins 2019) (Fig. 4A).

Specimens examined: Canada, British Columbia, Fraser-Fort George, near McBride, 53°18′38.7″N/120°07′44.8″W, alt. 862 m, birch forest with *Tsuga heterophylla* (Raf.) Sarg., 19 September 2018, on fallen deadwood, I. Stepanchikova 30 (LE); Kitimat-Stikine, vicinity of Kispiox, 55°28′34.4″N/127°52′39.1″W, alt. 525 m, old-growth western hemlock-western redcedar forest with *Menziesia ferruginea* Sm. and *Oplopanax horridus* (Sm.) Miq., 22 September 2018, on wood, I. Stepanchikova 39 (LE); *ibid*., near Mitten Lake, 55°32′29.8″N/128°01′59.8″W, alt. 621 m, old-growth wet mossy western hemlock-western redcedar forest with *Menziesia ferruginea* and *Oplopanax horridus*, 22 September 2018, on wood, I. Stepanchikova 41 (LE).

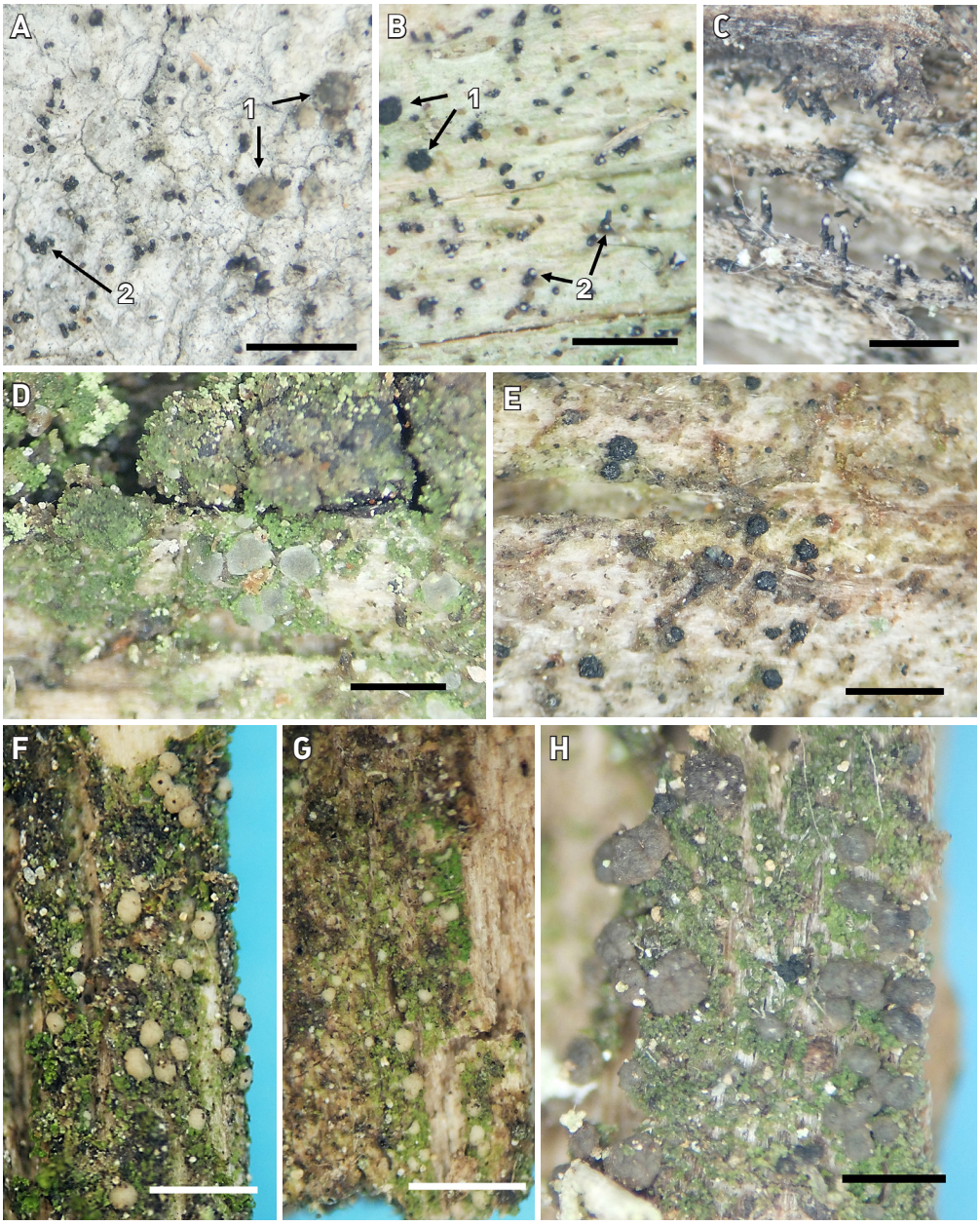

Fig. 2. Morphology of *Micarea* species: **A–C** – *M. botryoides* (1 – apothecia, 2 – pycnidia). **D** – *M. byssacea*. **E** – *M. contexta*. **F** – *M. fallax*. **G** – *M. laeta*. **H** – *M. prasina* s. str. Scale bars A, B, D–H = 1 mm, C = 0.5 mm.

Micarea fallax Launis & Myllys, Mycologia 111(4): 574–592. (2019) (Fig. 2F).

Type: Finland, Varsinais-suomi, Karkkila, Myllypuro, mixed forest between Lake Vahermanjärvi and Lake Tarkeelanjärvi, near Myllypuro River, on bark of *Pinus sylvestris*, in shaded and moist microhabitat, WGS84 lat. 60°33.18022′, long. 23°59.67047′, 10 September 2011, A. Launis 109115 (holotype: H!).

Description of studied specimens: Thallus poorly developed, granular, or membranous, vivid green, pale olive green to dark olive green. Apothecia cream white to pale brownish, usually hemispherical, sometimes slightly adnate, 0.15–0.4 mm, (0.2–0.4(–0.5) mm diam according to Launis et al. 2019a). Sedifolia-grey pigment present in epihymenium. Hymenium hyaline, 42–50 µm tall (35–45 µm tall according to Launis et al. 2019a). Hypothecium hyaline, 37.5 µm tall. Ascospores oblong-ellipsoid, 0–1-septate, 8–11 × 3–4 µm. Crystalline granules detected in polarized light in hymenium and thallus.

Chemistry: HPTLC: micareic acid. Epihymenium K± violet, C± violet (Sedifolia-grey pigment).

Note: This species can be confused with *M. prasina* s. str., which also contains micareic acid, but *M. fallax* is distinguished by the presence of crystalline granules only in the hymenium, while *M. prasina* s. str. has granules in the epihymenium. In addition, *M. fallax* has a poorly developed thallus and is more common on bark, whereas *M. prasina* s. str. usually forms a well-developed granular thallus and prefers decaying wood as a substrate. Specimens of *M. fallax* with slightly adnate apothecia without Sedifolia-grey pigment are similar to *M. laeta*, but are distinguished by the presence of micareic acid (Launis et al. 2019a).

Ecology and Distribution: In Europe *Micarea fallax* occurs on bark and decaying wood in mature managed and old-growth forests, where it is more common on bark, and less frequent on wood. Collections from Canada were found on bark and wood in old-growth forests, but the number of observations on wood is higher here than on bark. This seemingly contrasting pattern to observations from Europe may be the result of a still very small number of samples from Canada so far. World distribution: Europe – Finland, Belarus, Czech Republic, Scotland, Sweden (Launis et al. 2019a), European Russia (Stepanchikova et al. 2020, Tarasova et al. 2020) (Fig. 4B).

Specimens examined: Canada, British Columbia, Fraser-Fort George, near McBride, 53°26′35.4″N/120°30′53.7″W, alt. 885 m, old-growth western hemlock-western redcedar forest, 19 September 2018, deadwood of *Tsuga heterophylla*, I. Stepanchikova 32–33 (LE); ibid., near Prince George, along Yellowhead Hwy., 53°54′45.0″N/121°43′00.9″W, alt. 698 m, old-growth western redcedar-western hemlock forest, 21 September 2018, on bark of *Thuja plicata* Donn ex D.Don and *Tsuga heterophylla*, I. Stepanchikova 34 (LE); Wells Gray Country, near Clearwater, Silvertip Falls, 51°45′40.4″N/119°55′13.1″W, alt. 1502 m, fir trees near the waterfall, 30 September 2018, on wood of *Abies lasiocarpa* (Hook.) Nutt., I. Stepanchikova 87 (LE); ibid., 51°45′22.7″N/119°55′23.6″W, alt. 1384 m, fir trees near the waterfall, 30 September 2018, on wood of *Abies lasiocarpa*, I. Stepanchikova 92 (LE).

Additional specimen examined: Sweden, Småland, Västra Ed parish, 1.7 km ESE of Forsby manor house, about 200 m E of Ingelsberg, 58°06′N/16°58′E, on hard wood on stump of *Pinus sylvestris* in mixed coniferous swamp forest, 28 December 2011, M. Svensson 2398b (H).

Micarea pseudomicrococca Launis & Myllys, Lichenologist 51(1): 7–25 (2019) (Fig. 3B).

Type: Finland, Etelä-Häme, Jämsä, Hallinmäki Nature Reserve, *Betula* sp./*Picea abies*-dominated oldgrowth forest, on bark of decaying *Betula* stump, YKJ E3401759, N6894425, 2015, A. Launis 59151 (holotype: H!).

Description of studied specimen: Thallus effuse, olive green, sometimes partly bright green, composed of goniocysts, usually forming larger granules. Apothecia convex, white to pale brownish, 0.2–0.4 mm in diam. (up to 0.5 mm when tuberculate), apothecia predominantly 0.2 mm in diam. ((0.2)–0.26–(0.5) mm in diam., N=12). Epihymenium hyaline, hymenium hyaline, up to 60 µm tall (35–50 µm tall according to Launis et al. 2019b), hypothecium hyaline. Paraphyses of two types, not branched or badly branched, up to 1.0 µm in width, apices not thickened, and up to 2.0 µm wide with thickened apices. Ascospores ellipsoid to obovoid, 0-1-septate, 8–11 × 2–2.7 µm (8–14(–15) × 2.0–3.2 µm according to Launis et al. 2019b). Crystals studied in polarized light present in hymenium and thallus. Pycnidia cream-white. Conidia 7.5 × 0.8 µm.

Chemistry: HPTLC: methoxymicareic acid. Thallus K–, C–. Apothecieal section K–, C–.

Note: Our specimen of *M. pseudomicrococca* clearly differs from the closely related *M. micrococca* by a two-colored thallus (mostly olive green, but in parts bright green), consisting of large granules and the presence of two types of paraphyses. *Micarea pseudomicrococca* differs from another closely related species, *Micarea czarnotae* Launis et al., by the absence of Sedifolia-grey pigment in the apo-

thecia and present crystalline granules in thallus. *Micarea czarnotae* has recently been reported from Alaska (Spribille et al. 2020). The ascospores in our specimens are apparently poorly developed, because they are smaller (both shorter and narrower) in comparison with the protologue (Launis et al. 2019b) and only a few of them could be found. Due to the small ascospores and two-colored thallus our samples can be confused with *M. microareolata* Launis et al. However, *M. microareolata* has adnate apothecia and only one type of paraphyses.

Ecology and Distribution: It prefers bark of deciduous or sometimes coniferous trees in humid situations. World distribution: Europe – Finland and Scotland (Launis et al. 2019b), Kalinigrad Region (Konoreva et al. 2020) (Fig. 4C).

Specimen examined: Canada, British Columbia, North Coast, Haida Gwaii, Graham Island, vicinity of Masset, 54°01′47.1″N/132°03′15.1″W, alt. 12 m, secondary alder forest, 24 September 2018, on bark of *Alnus rubra* Bong., I. Stepanchikova 58 (LE).

Additional specimen examined: USA, Maine, Hancock County, Acadia National Park, Mt. Desert Isl. 1 mi. E of Jordan Pound (SE of Pemetic Mt.), in mature spruce and *Thuja* woods with some maple and along rock outcrops, 11 July 1984, on spruce, T. J. Sullivan 3590 (MIN 798136, sub *M. prasina*).

Micarea pusilla Launis et al., Mycologia 111(4): 574–592 (2019) (Fig. 3C).

Type: Finland, Uusimaa: Tuusula, near Korso, shaded and dense *Picea abies*–dominated managed forest, on wood of fallen decaying (early stage) *Picea abies* (L.) H.Karst., WGS84 lat. 60°21.26638′, long. 25°1.93227′, 10 October 2013, A. Launis 101035 (holotype: H!).

Description of studied specimens: Thallus usually inconspicuous or granular, warted-granular or membranous; apothecia numerous, whitish, crowded, very small, 0.05–0.1 mm in diam. ((0.07–) 0.1–0.15(–0.2) mm in diam. according to Launis et al. 2019a). Sedifolia-grey pigment absent. Hymenium hyaline, 30–35 µm tall, hypothecium hyaline. Ascospores oblong-ellipsoidal, 0-1-septate, 5–7 × 2.5 µm (7–9(–9.5) × 2–3 µm according to Launis et al. 2019a). Pycnidia not seen in our material. Crystalline granules not detected in polarized light in sections of the apothecia or thallus.

Chemistry: HPTLC: methoxymicareic acid. Epihymenium and thallus K–, C–.

Note: *Micarea pusilla* resembles species of the *M. micrococca*-group, but is not closely related to them (Launis et al. 2019a). It is easy to distinguish by its very small, numerous and crowded whitish apothecia, olive-green warted-granular or membranous thallus, the absence of Sedifolia-grey in the epihymenium, and the absence of the crystalline granules visible in polarized light in apothecia and thallus.

Ecology and Distribution: In North American material this species prefers deadwood in coniferous-dominated mixed forests. In Europe, some specimens have been collected from bark. World distribution: Europe – Finland, Czech Republic (Launis et al. 2019a), European Russia (Konoreva et al. 2020, Tarasova et al. 2020), Asia – Caucasus (Launis et al. 2019a) (Fig. 5A).

Specimens examined: Canada, British Columbia, Fraser-Fort George, near McBride, 53°19′22.3″N/120°08′15.0″W, alt. 1127 m, fir-birch forest, 19 September 2018, on fallen deadwood, I. Stepanchikova 23 (LE), GenBank voucher MW227661; ibid., 53°18′48.1″N/120°07′57.8″W, alt. 874 m, birch forest with western redcedar and western hemlock near the creek, 19 September 2018, on wood of *Tsuga heterophylla*, I. Stepanchikova 29 (LE), GenBank voucher MW227662; ibid., 53°19′37.5″N/120°08′08.7″W, alt. 1321 m, old-growth western hemlock forest with aspen, *Populus tremuloides* Michx., 19 September 2018, on fallen dead wood, I. Stepanchikova 24 (LE), GenBank voucher MW227659.

Additional specimens examined: Czech Republic, Moravia, Kunštat, inter pagos Jasinov et Rudka, 500 m.s.m., corticicola in ramulis *Piceae excelsae*, 27 September 1976, A. Vězda (A. Vězda Lich. Selecti Ex. 1467, sub *M. prasina*) (H, DUKE 0346771); ibid., in valleculo sylvatico haud procul pagi Mokra Hora (prope urbem Brno), 260 m.s.m., ad corticem *Aceris platanoidis*, 23 May 1961, A. Vězda (A. Vězda Lich. Selecti Ex. 90, sub *Catillaria prasina*) (H). Germany, Schleswig-Holstein, an dürren Fichtenzweigen im Nadelwald südl. von Tarp, Kreis Flensburg, 13 January 1929, Saxen (Herb. W.L. Culberson) (DUKE 0346757, sub *Catillaria micrococca*); Kreis Flensburg, im Forst Lindewitt, an dürren Fichtenzweigen [=in forest near Lindewitt on dry spruce twigs], 4 December 1955, Saxen (DUKE 0346766); ibid., an dürren Zweigen von *Picea abies* [=on dry spruce twigs], 6 March 1960, Saxen (DUKE 0346758, sub *Catillaria micrococca*).

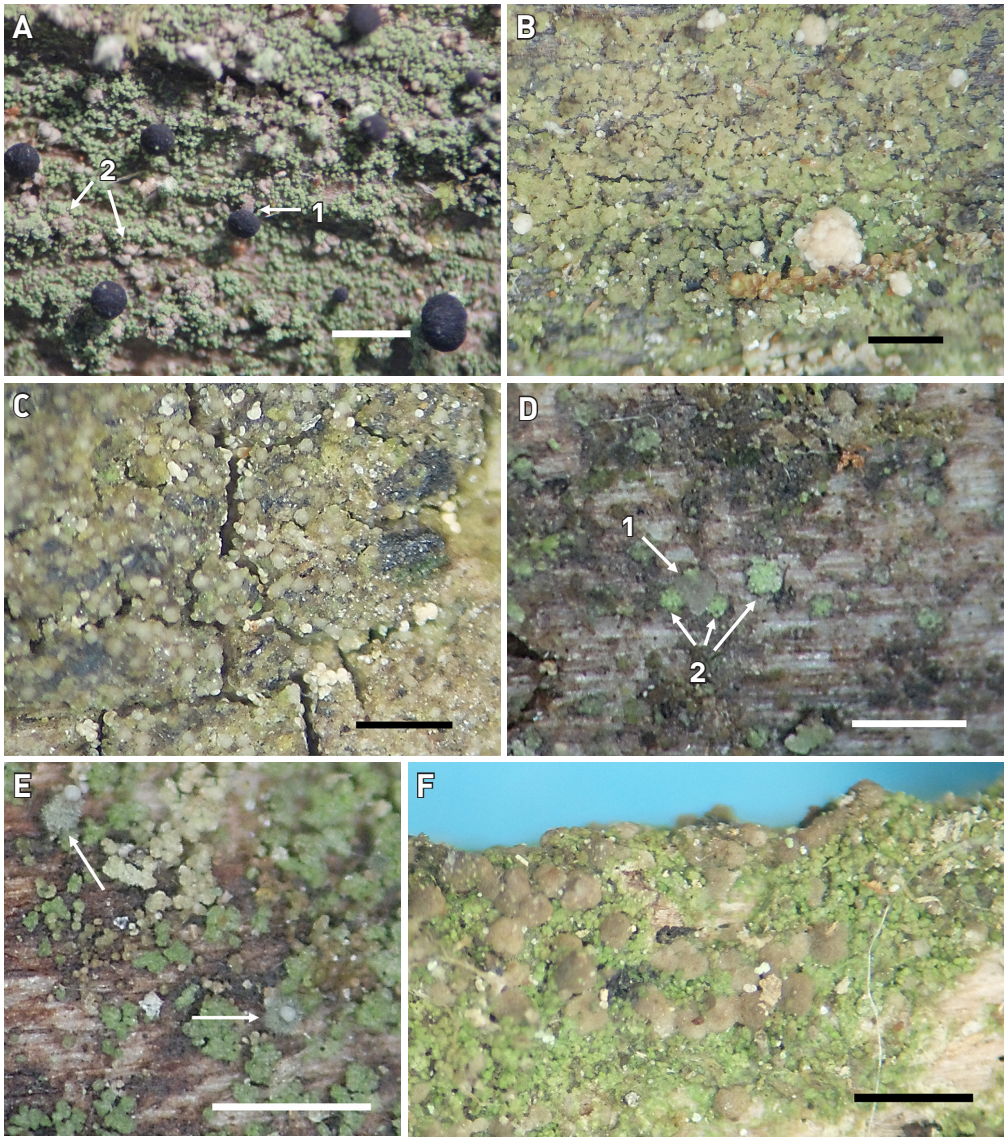

Fig. 3. Morphology of *Micarea* species: **A** – *M. inopinual* (**1** – apothecia on short-stalks, **2** – cephalodia). **B** – *M. pseudomicrococca*. **C** – *M. pusilla*. **D** – *M. soralifera* (**1** – apothecia, **2** – soralia). **E–F** – *M. tomentosa*. **E** – pycnidia, **F** – apothecia. Scale bars A–B = 1 mm, C–E = 0.5 mm.

Micarea tomentosa Czarnota & Coppins, Polish Botanical Studies 23: 1–199 (2007) (Fig. 3E, F).

Type: Poland, Middle Roztocze, Roztoczański National Park, Kosobudy forest division, Stogi forest district, forest section no. 178b [50°35'42"N/23°04'42"E] alt. ca 260 m, on bark of *Abies alba* Mill., at the base of trunk within shady fir forest, 28 April 2004, P. Czarnota 3949 (holotype: GPN).

Description of studied specimen: Thallus bright green, composed of small goniocysts. Apothecia numerous, adnate, brownish 0.2–0.4 mm (0.15–0.3 mm according to Czarnota 2007). Epihymenium brownish. Hymenium 35–42.5 µm tall (35–40 µm tall according to Czarnota 2007). Hypothecium

hyaline, up to 75 µm tall (ca 70 µm tall according to Czarnota 2007). Ascospores (0-)1-septate, 7.5–9(–11) × 2.5–3.0 µm. Pycnidia rare, only on the thalli without apothecia. Conidia oblong cylindrical, 3–3.5 × 1.2 µm. Crystalline granules not detected in polarized light in apothecia and thallus.

Chemistry: No substances detected by HPTLC. Thallus and apothecial section K–, C–. Pycnidial walls K± violet-grey.

Note: *Micarea tomentosa* can be easily distinguished from *M. hedlundii* Coppins by the absence of Intrusa-yellow pigment in the goniocysts of the thallus, and sessile to shortly stalked pycnidia covered by tomentum (Czarnota 2007) and from *M. fennica* Launis & Myllys by the absence of substances detectable by HPTLC (*M. fennica* produces micareic acid) (Launis & Myllys 2019). In European and Asian material pycnidia are very common, whereas our specimen from North America has few pycnidia and abundant apothecia.

Ecology and Distribution: World distribution: Europe – Poland (Czarnota 2007), Sweden (Thor & Svensson 2008), Estonia (Suija et al. 2008), Finland (Myllys & Launis 2018), Czech Republic (Malíček et al. 2018b), Norway (Klepsland 2020), European Russia (Urbanavichene & Urbanavichus 2017, Muchnik et al. 2019, Stepanchikova et al. 2020, Tarasova et al. 2020), Asia (Konoreva et al. 2018, 2019) (Fig. 5C).

Specimens examined: Canada, Alberta, Lesser Slave River, NW of Athabasca, Marten Lakes, 55°36′21.7″N/114°33′23.0″W, alt. 777 m, old-growth spruce forest with balsam fir (*Abies balsamea* (L.) Mill.) and aspen, 15 September 2018, on wood, I. Stepanchikova 15 (LE), GenBank voucher MW227660.

New To Canada

Micarea byssacea (Th.Fr.) Czarnota et al., Lichenologist 42: 7–21 (2010). ≡ *Catillaria prasina* [var.] *byssacea* Th.Fr., Lich. Scand. 2: 573 (1874) [Basionym]. ≡ *Biatora byssacea* Zwackh, Flora 45: 510 (1862), non Hampe Linnaea 25: 709 (1852); nom. illeg. (Art. 53.1). ≡ *Micarea prasina* f. *byssacea* (Th. Fr.) Hedl., Bih. Kongl. Svenska Vetensk.-Akad. Handl. III, 18(3): 87 (1892). ≡ *Lecidea byssacea* (Th. Fr.) Vain., Természetr. Fuz. 22: 320 (1899) (Fig. 2D).

Type: Germany, Baden-Württemberg, Heidelberg, ‘Königstuhl’, on bark of young *Quercus*, 1880, Zwackh 177 (neotype: H-NYL21618!).

Description of studied specimens: Thallus granular, composed of small goniocysts, green to olive-green. Apothecia mostly adnate, 0.2–0.3 mm in diam., whitish-grey to grey. Hymenium hyaline to greyish, up to 40 µm tall, Sedifolia-grey pigment present in epihymenium. Hypothecium hyaline, up to 100–125 µm tall. Ascospores ovoid to ellipsoid, 0–1-septate, 7.5–12 × 3–4 µm ((6–)8–12(–13) × 2.7–3.5(–4.2) µm according to Launis & Myllys 2014). Pycnidia not seen in our specimens. Crystalline granules detected in polarized light in hymenium and thallus.

Chemistry: HPTLC: methoxymicareic acid. Epihymenium K+ violet and C+ violet. Thallus K–, C–.

Note: *Micarea byssacea* is distinguished from closely related species in the *M. micrococca* group by adnate apothecia. It differs from the morphologically similar species *M. laeta* and *M. microareolata* by the presence of Sedifolia-grey pigment in the apothecia, and a minutely granular thallus that rarely coalesces to form larger granules, or a continuous crust and is never areolate (Launis et al. 2019b).

Ecology and Distribution: *Micarea byssacea* prefers bark of coniferous and deciduous trees in humid forests. World distribution: Europe – Germany, Sweden, Finland, Czech Republic, Estonia, Lithuania, Poland, Slovakia (Czarnota & Guzow-Krzemińska 2010), Portugal (van den Boom 2017), Latvia (Motiejūnaitė et al. 2016), European Russia (Stepanchikova et al. 2017, Himelbrant et al. 2018, Konoreva et al. 2020), North America – USA (Launis & Myllys 2014).

Specimens examined: Canada, British Columbia, North Coast, Haida Gwaii, Graham Island, vicinity of Masset, 54°01′47.1″N/132°03′15.5″W, alt. 12 m, secondary alder forest, 24 September 2018, on bark of *Alnus rubra*, I. Stepanchikova 58 (LE); ibid., Rennel Sound Bay, seashore, 53°25′28.5″N/132°35′15.8″W, alt. 4 m, coastal coniferous forest, 25 September 2018, on bark of *Tsuga heterophylla*, I. Stepanchikova 62 (LE).

Additional specimens examined: USA, California, Humboldt County, near Samoa Bridge on the bay-side of the Samoa Peninsula, [40°49′N/124°11′W], 28 March 1998, on *Pinus contorta* Douglas ex Loudon, D. Glavich

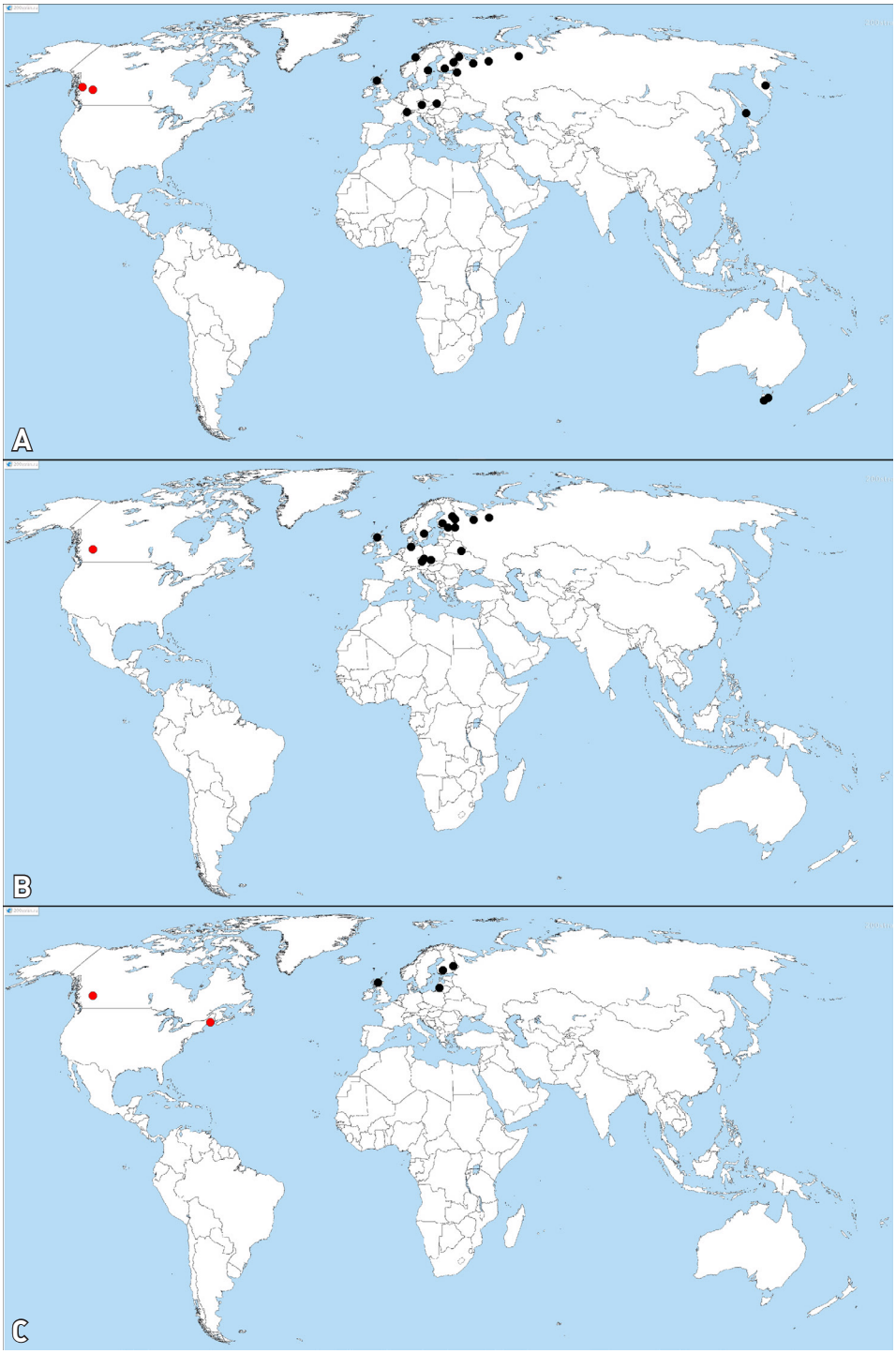

Fig. 4. Distribution of *Micarea contexta* (**A**), *M. fallax* (**B**) and *M. pseudomicrococca* (**C**) in the world. Red dots – new data, black dots – literature data.

(SBBG 928, sub *M. prasina*). Illinois, Effingham County, ca. 5 miles west of Effingham, south of Lake Sara, in white oak savanna south of Lake Sara Road, T8N, R5E, Sec. 22 [39°06′N/88°37′W], in the SW 1/4 SE 1/4, 29 April 1990, on *Quercus alba* L., G. Wilhelm 18038, D. Ladd (MOR L-0008414, sub *M. prasina*); Du Page County, South of Darien at Waterfall Glen Forest Preserve, [41°52′N/88°02′W], 8 March 1987, on old log, G. Wilhelm 14647 (MOR L-0008415, sub *M. prasina*). Maine, Washington County, town of Beals, Great Wass Island reserve, 44°28′52″N/67°35′41″W, open *Pinus banksiana* Lamb. forest, with heathy understory of *Kalmia*, *Ledum*, *Rhododendron canadense* (L.) Torr. etc., 6 June 2012, on bark of an old *Pinus* spp., A. Launis 66128, S. Clayden (H); ibid., Town of Steuben, Dyer Neck, Eagle Hill, Eagle Hill Institute, 44°27′34″N/67°55′54″W, humid mixed forest dominated by *Picea rubens* Sarg., *Abies*, *Betula* and *Acer rubrum* L., 11 June 2012, on bark of shaded *Acer*, near ground, A. Launis 116123 (H). Michigan, Berrien County, East of Union Pier, at Warren Woods State Park, [41°49′N/86°37′W], 3 May 1986, on *Acer saccharinum*, G. Wilhelm 13809 (MOR L-0008413, sub *M. prasina*). North Carolina, Carteret County, SW of Morehead City on Bogue Banks, North Carolina Marine Aquarium, 34°41′N/76°49′W, coastal maritime forest with *Quercus laurifolia* Michx., *Ilex opaca* Aiton, *Carpinus caroliniana* Walt., 24 October 1998, on *Ilex* trunks, R. Yahr 1552 (DUKE 0001702, sub *Micarea* sp.); Haywood County, Great Smoky Mountains National Park, 3 miles southeast of Waterville, along Baxter Creek Trail, south of Big Creek Campsite, Mount Sterling Ridge, lower slope of Mount Sterling, Cove Creek Gap Quad, 35°44′23″N/83°06′45″W, 2700 ft. [823 m], Rich cove forest (*Aesculus hippocastanum* L., *Acer saccharinum*, *Liriodendron tulipifera* L., *Betula lenta* L., *Halesia carolina* L.) on north-facing slope, including rocky tributary to Baxter Creek, 29 October 2006, on the base od *Tsuga*, J. C. Lendemer 8231, E. Tripp (DUKE 0131783, sub *M. prasina*).

Micarea laeta Launis & Myllys, Lichenologist 51(1): 7–25 (2019) (Fig. 2G).

Type: Finland, Etelä-Häme, Jyväskylä, Korpilahti, *Picea abies*-dominated mixed managed forest, on bark of standing decaying *Betula* sp., on shaded N-side of the tree, YKJ E3418597, N6885262, 5 September 2015, A. Launis 59153a (holotype: H!), 59153b (isotype: E).

Description of studied specimens: Thallus composed of goniocysts, usually coalescing to form larger granules or an almost continuous crust, vivid green to olive-green. Apothecia adnate, convex to hemispherical, whitish to creamy-white or brownish, 0.15–0.35 mm diam. (0.3–0.5(–0.6) mm, up to 0.6 mm diam. if tuberculate according to Launis et al. 2019b). Hymenium hyaline, 45–50 µm tall. Hypothecium hyaline, 35–40 µm tall (35–50 µm tall according to Launis et al. 2019b). Ascospores 0-1-septate, 8–12 × 3–4 µm. Crystals visible in hymenium and thallus in polarized light.

Chemistry: HPTLC: methoxymicareic acid. Thallus and apothecial section K–, C–.

Note: *Micarea laeta* differs from the closely related species *M. byssacea* and *M. microareolata* by wider spores (up to 3.0 µm in width in *M. microareolata* according to Launis et al. 2019b and up to 3.5 (rarely up to 4.2) µm in width in *M. byssacea* (Czarnota & Guzow-Krzemińska 2010)). Additionally, *M. laeta* does not produce Sedifolia-grey pigment in the apothecia in contrast to *M. byssacea* (Launis et al. 2019b).

Ecology and Distribution: This species prefers wood in old-growth mixed forest in North America. In Europe *M. laeta* prefers bark. World distribution: Europe – Finland, Sweden (Launis et al. 2019b), Austria, Germany, Great Britain (Konoreva et al. 2019), European Russia (Tarasova et al. 2020), Asia – Russian Far East, North America – USA (Konoreva et al. 2019).

Specimens examined: Canada, Alberta, Lesser Slave River, NW of Athabasca, Marten Lakes, 55°36′37.7″N/114°34′16.5″W, alt. 802 m, 15 September 2018, on wood of conifers, I. Stepanchikova 8 (LE); ibid., 55°36′31″N/114°33′39″W, alt. 797 m, old-growth spruce forest with balsam fir and aspen, 16 September 2018, on wood, I. Stepanchikova 11 (LE), GenBank voucher MW227658; ibid., 55°36′21.7″N/114°33′23.0″W, alt. 777 m, old-growth spruce forest with fir and aspen, 15 September 2018, on wood, I. Stepanchikova 15 (LE); Yellowhead County, near Nojack, Township Road 120, 2.7 km S of Hwy. 16, 53°35.070′N/115°37.341′W, alt. 821 m, mixed older woodland of *Populus tremuloides*, *Picea glauca* (Moench) Voss and *Abies balsamea*, 9 May 2018, *Picea* bark base of tree, T. Spribille s.n., R. Evashkevich, S. Goyette (ALTA).

Additional specimens examined: Denmark, Langeland, Naebbeskov beach, pasture by the seashore, *Calluna* heath with scrubs, fence posts and boulders, 11 May 1991, S. Svane 583 (H).

Micarea microareolata Launis et al., Lichenologist 51(1): 7–25 (2019).

Type: Finland, Etelä-Savo, Jyväskylä, Korpilahti, *Picea abies*-dominated mixed managed forest, on bark of standing decaying *Picea abies*, YKJ E3418403, N6885234, 2015, A. Launis 59152 (holotype: H!).

Description of studied specimens: Thallus composed of goniocysts, usually coalescing to form convex to subglobose small areolae, pale olive-green to whitish green or partly bright green. Apothecia adnate, whitish cream, up to (0.15–)0.2–0.3 mm (0.3–0.6 mm according to Launis et al. 2019b). Hymenium hyaline, (37.5–)45–57.5 µm tall (30–45 µm according to Launis et al. 2019b), hypothecium hyaline, up to 50 µm. Ascospores 0–1-septate, (7–)9–12 × 2–3 µm. Crystalline granules were detected in polarized light in the hymenium and thallus.

Chemistry: HPTLC: methoxymicareic acid. Thallus and apothecial section K–, C–.

Note: *Micarea microareolata* is distinguished from *M. byssacea* by the absence of Sedifolia-grey pigment in apothecia and from *M. laeta* by its thallus structure and narrower ascospores (Launis et al. 2019b).

Ecology and Distribution: This species occurs on bark of conifers (*Picea*, *Thuja* and *Tsuga* as well as deadwood in various forest types, especially near lakes, rivers and seashores. World distribution: Europe – Finland, Sweden (Launis et al. 2019b), Germany, Czech Republic (Konoreva et al. 2019), European Russia (Konoreva et al. 2019, 2020, Stepanchikova et al. 2020, Tarasova et al. 2020), Asia – Russian Far East, North America – USA (Konoreva et al. 2019).

Specimens examined: Canada, Alberta, Lesser Slave River, NW of Athabasca, Marten Lakes, 55°36′37.7″N/114°34′16.5″W, alt. 802 m, old-growth spruce forest with fir and aspen, 15 September 2018, on wood, I. Stepanchikova 8 (LE). British Columbia, Fraser-Fort George, near McBride, 53°25′31.7″N/120°27′13.7″W, alt. 905 m, old-growth western redcedar-western hemlock forest, 18 September 2018, on bark and wood of *Thuja plicata*, I. Stepanchikova 16-17 (LE); ibid., 53°25′32″N/120°27′14″W, alt. 908 m, old-growth western redcedar-western hemlock forest, 18 September 2018, on wood, I. Stepanchikova 16 (LE); ibid., 53°26′35.4″N/120°30′53.7″W, alt. 885 m, old-growth western redcedar-western hemlock forest, 19 September 2018, on fallen deadwood of *Tsuga heterophylla*, I. Stepanchikova 32-33 (LE); North Coast, Haida Gwaii, Graham Island, Pacific Ocean coast near Masset, 54°01′49.1″N/132°03′15.5″W, alt. 0–7 m, among spruces along sandy seashore, 24 September 2018, on *Vaccinium* sp., I. Stepanchikova 59 (LE); Skeena-Queen Charlotte, valley of Skeena River, near Khyex River mouth, 54°14′00.1″N/129°52′16.5″W, alt. 11 m, western redcedar-Sitka spruce forest near the Yellowhead Hwy., 28 September 2019, on bark of *Picea sitchensis* (Bong.) Carrière and *Thuja plicata*, I. Stepanchikova 83 (LE).

Micarea soralifera Guzow-Krzem. et al., Lichenologist 48(3): 161–169 (2016) (Fig. 3D).

Type: Poland, Równina Bielska, Białowieża Primeval Forest, Białowieża National Park, forest section no. 256, Circaeo-Alnetum, on log, October 2014, M. Kukwa 13001 & A. Łubek (holotype: UGDA; isotype: KTC).

Description of studied specimen: Thallus crustose, greyish green to dull green, sorediate. Soralia green or greyish green, well-delimited, rounded, 0.1–0.2 mm, in old parts of thallus forming leprose crust. Apothecia pale greyish brown to greyish, 0.15–0.2 mm diam., convex. Epihymenium greyish, Sedifolia-grey pigment present. Hymenium up to 35 µm tall. Hypothecium hyaline, up to 50 µm tall. Ascospores 0-1(-2)-septate, ovoid to ellipsoid, 9–13 × 2.5–3 µm (6–12 × 3.5–4.5 µm according to Guzow-Krzemińska et al. 2016). Crystalline granules detected in polarized light present in thallus, but absent in apothecial section.

Chemistry: HPTLC: micareic acid. Epihymenium, soralia and thallus K+ violet, C+ violet (Sedifolia-grey pigment).

Note: Distinguished from *M. prasina* s. str. by the presence of well delimited soralia (Guzow-Krzemińska et al. 2016). Other sorediate species such as *M. viridileprosa* Coppins & van den Boom differ in containing gyrophoric acid (van den Boom & Coppins 2001), *M. coppinsii* Tønsberg has 3-septate ascospores and produces 5-0-methylhiascic acid (Tønsberg 1992) while *M. microsorediata* Brand et al. contains methoxymicareid acid (Guzow-Krzemińska et al. 2019). *Micarea flavoleprosa* Launis et al. also produces micareic acid as a secondary metabolite, but differs in a thick, yellowish green to whitish green thallus, composed of minute soredia or small goniocysts, which often coalesce to form larger granules and the absence of Sedifolia-grey pigment in apothecia and thallus (Launis et al. 2019a).

Ecology and Distribution: *Micarea soralifera* prefers wood of logs in old-growth forests. World distribution: Europe – Poland, Czech Republic (Guzow-Krzemińska et al. 2016), Sweden (Svensson

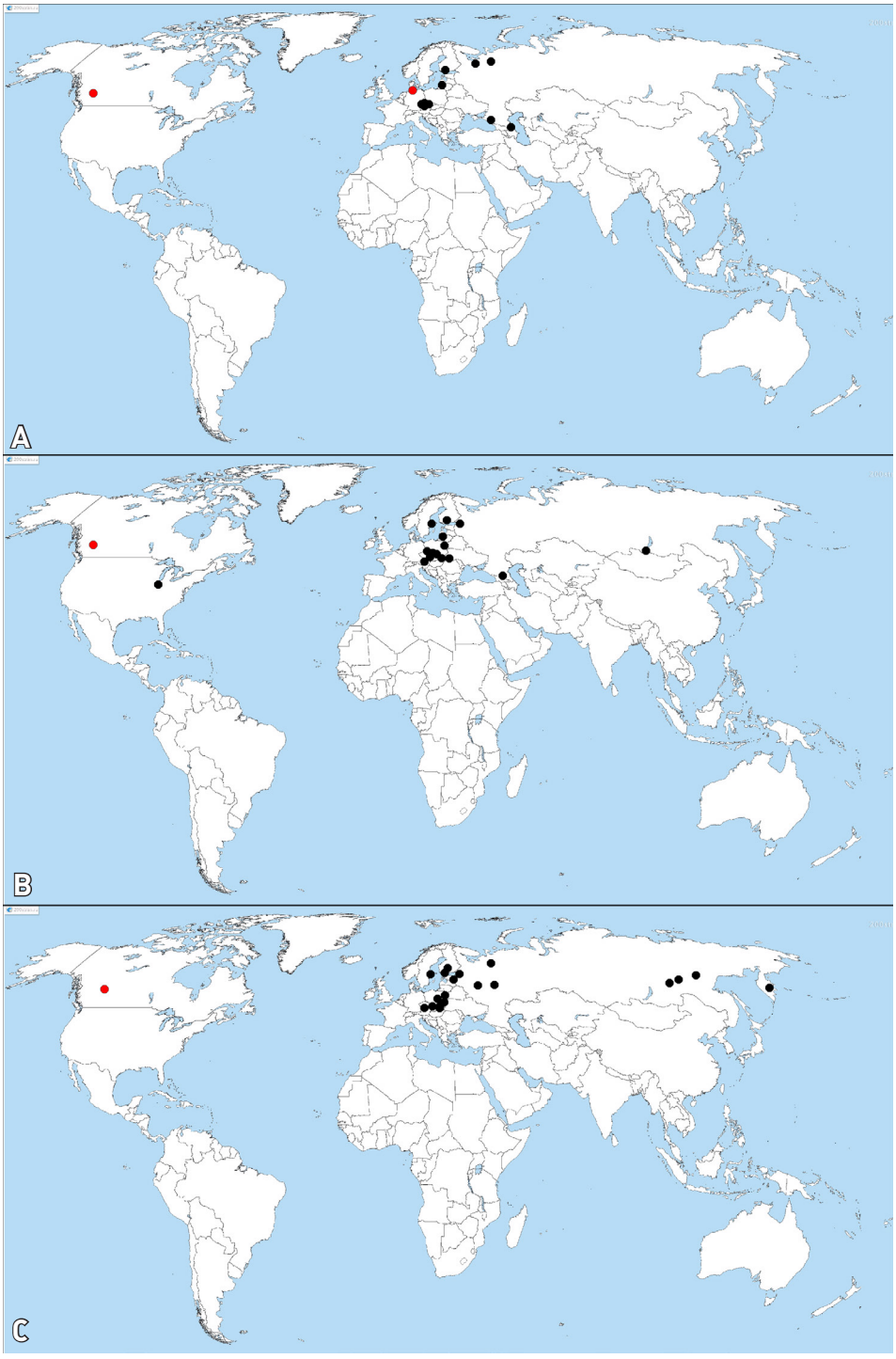

Fig. 5. Distribution of *Micarea pusilla* (**A**), *M. soralifera* (**B**) and *M. tomentosa* (**C**) in the world. Red dots – new data, black dots – literature data.

et al. 2017), Austria (Berger et al. 2018), Slovakia (Guttová et al. 2018), Finland (Myllys & Launis 2018), Ukraine (Malíček et al. 2018a), European Russia (Konoreva et al. 2020, Stepanchikova et al. 2020), Asia – Caucasus (Urbanavichus & Urbanavichene 2017), Siberia (Urbanavichene et al. 2018), North America – USA (Lendemer 2017) (Fig. 5B).

Specimens examined: Canada, British Columbia, Fraser-Fort George, along Hwy. 16 ca. 14 km E of Purden Lake, 53°54′45.0″N/121°43′00.9″W, alt. 698 m, old-growth western hemlock-western redcedar forest, 21 September 2018, on bark of *Thuja plicata* and *Tsuga heterophylla*, I. Stepanchikova 34 (LE).

Records of rare and interesting species

Micarea botryoides (Nyl.) Coppins, Lichenologist 12: 107. (1980). ≡ *Lecidea apochroeella* var. *botryoides* Nyl., Flora 50: 373. 1867. ≡ *Lecidea botryoides* (Nyl.) Zahlbr., Cat. Lich. Univ. 3: 740. 1925 (Fig. 2A–C).

Type: Finland, Tavastia australis, Lammi, Evo, Lapinkallio, 1866, J. P. Norrlin 404 (lectotype: H-NYL 20685!; isolectotype: H!); 1873, J. P. Norrlin (topotype: H!).

Description of studied specimens: Thallus thin, scurfy-granular. Apothecia to 0.2–0.3 mm diam. (0.25 mm diam. (to 0.5 mm when tuberculate) according McCune 2017). Epihymenium olive-green, K+ greenish. Hymenium with brownish streaks that are K+ olivaceous, 37.5–47.5 µm. Hypothecium dark reddish brown, 75–125 µm. Exciple poorly developed. Ascospores 0–1-septate, (7–)10–12 × 3–4 µm. Pycnidia black, to 0.4 mm tall, the wall dark greenish brown, K+ intensifying green. Crystalline granules are absent in the thallus and apothecia.

Chemistry: No substances detected by HPTLC.

Note: Sterile specimens on wood differ from *M. misella* (Nyl.) Hedl. and *M. nigella* Coppins in pigmentation of the pycnidial wall (Coppins 1983, Smith et al. 2009). *Micarea melaeniza* Hedl. is similar to *M. botryoides* in terms of apothecial and pycnidial pigmentation and structure, but differs mainly in its endoxylic or whitish, slightly areolate thallus (Coppins 1983, Czarnota 2007).

Ecology and Distribution: *Micarea botryoides* prefers wood and bark of conifers in conifer-dominated forests, though it also rarely occurs on deciduous bark. It is a rare species in North America and was only known from the USA (McCune 1996). There is no literature data for Canada, but there are data from British Columbia at GBIF (https://www.gbif.org/species/2607392). These specimens have not been examined by the authors of this study. World distribution: Europe, Asia, North America (Coppins 1983, Czarnota 2007, Smith et al. 2009, McCune 2017, Spribille et al. 2020).

Specimens examined: Canada, British Columbia, Skeena-Queen Charlotte, north of Skeena River approximately 60 km east of Prince Rupert, 54°15′07.7″N/129°26′41.1″W, alt. 10 m, on bark of *Alnus rubra*, 9 September 2018, P. Williston 9006 (LE); Kitimat-Stikine, between Terrace and Kitimat, vicinity of Lakelse Lake, 54°19′36.9″N/128°31′59.6″W, alt. 242 m, open western hemlock forest with western redcedar, 23 September 2018, on wood of *Thuja plicata*, I. Stepanchikova 44 (LE); North Coast, Haida Gwaii, Graham Isand, vicinity of Masset, hilltop, 54°01′21.1″N/131°58′35.6″W, alt. 42 m, old-growth western redcedar-western hemlock forest, 24 September 2018, on bark of *Thuja plicata* and dead *Tsuga heterophylla*, I. Stepanchikova 54 (LE); Wells Gray Country, near Clearwater, 51°45′40.4″N/119°55′13.1″W, alt. 1502 m, fir trees near the waterfall, 30 September 2018, on wood of *Abies lasiocarpa*, I. Stepanchikova 87 (LE).

Micarea inopinula (Nyl.) Coppins & T. Sprib., Lichenologist 53: 40 (2021). ≡ *Lecidea inopinula* Nyl., Lich. Jap.: 71 (1890); *Catillaria inopinula* (Nyl.) Zahlbr., Cat. Lich. Univ. 4: 18 [as "*inopulina*"] (1926).

= *Micarea prasinella* (Jatta) I.M.Lamb, Lilloa 26: 413 (1954). ≡ *Biatorina* [as '*Biarotina*'] *prasinella* Jatta, Bolletino della Società Botanica Italiana 1911: 257 (1911). ≡ *Catillaria prasinella* (Jatta) Zahlbr., Catalogus Lichenum Universalis 4: 67 (1926) (Fig. 3A).

Type: Japan, Fuji, Itjigome [Itchigômé], "super truncos putrescentes inter Jungermannias", 1879, E. Almquist (lectotype: H-NYL; syntype: S).

Description of studied specimens: Thallus areolate, pale green to olive-green, soralia and cephalodia present. Cephalodia containing *Nostoc*. Apothecia black, short-stalked, 0.2–1 mm diam. 0.4–0.75 mm

tall (0.15–0.6 mm diam. according to Smith et al. 2009). Epihymenium brown, hymenium brownish, 50–55 µm tall. Hypothecium dark purple-brown, up to 125 µm tall. Ascospores ellipsoid, 0–1 septate, 15–17 × 5–7 µm. Crystalline granules detected in polarized light in epihymenium, exciple and thallus.

Chemistry: Gyrophoric acid (thallus C+ red), hymenium K+ green, epihymenium K+ green or purple-violet.

Note: Easily distinguished by the short-stalked, 'calicioid' apothecia, and presence of cephalodia. *Micarea melaena* is similar due to similar pigmentation of apothecial structures, but that species has sessile apothecia and mainly 3-septate ascospores. *Helocarpon crassipes* Th.Fr. differs in apothecia that are distinctly marginate when young, and the absence of gyrophoric acid.

Ecology and Distribution: This species inhabits deadwood, the bark of coniferous trees, and mossy roots in old-growth forests. World distribution: Japan (Coppins et al. 2021), Europe, North America (Alaska, Oregon), South America (Chile), New Zealand, Tasmania (Smith et al. 2009).

Specimens examined: Canada, British Columbia, Nelson Island, Sunshine Coast, shortly west of Bruce Lake, 49°41.1′N/124°8.9′W, over *Frullania* on branch of *Thuja*, margin of fen, 7 August 2008, Björk 17266 (UBC); Vancouver Island, Shortly north of Ucluelet, along Wild Pacific Trail, 48°56.3′N/125°34.1′W, over moss on *Picea* trunk, limestone coastal outcrop, 17 September 2009, Björk 19945 (UBC); Wells Gray Country, Columbia Mountains, Clearwater Valley, Grouse Creek Notch, 51°51.2′N/119°58.1′W, over moss on boulder talus, siliceous rock, cold-air drainage, 3 November 2010, Björk 21794 (UBC); North Coast, Skeena Estuary, Smith Island, east shore, south of the Cassiar Cannery, 54°9.5′N/130°9.9′W, over moss on rocky slope above tide line, 1 August 2017, Björk 44432 (UBC); Central Kootenay, Gardner Falls on Gardner Creek just above confluence with Kuskanax River, 50°17′10.8″N/117°43′48.5″W, lignicolous on soft wood, 3 September 2013, T. Spribille 40300, P. Resl (hb. Spribille); Fraser-Fort George, near Prince George, 53°54′45.0″N/121°43′00.9″W, alt. 698 m, old-growth western hemlock-western redcedar forest, 21 September 2018, on bark of *Thuja plicata* and *Tsuga heterophylla*, I. Stepanchikova 34 (LE); Kitimat-Stikine, vicinity of Kispiox, near Mitten Lake, 55°27′14.7″N/127°51′16.9″W, alt. 510 m, old-growth western hemlock-western redcedar forest, fallen deadwood, 22 September 2018, on wood of *Tsuga heterophylla*, I. Stepanchikova 35-36 (LE); ibid., 55°28′34.4″N/127°52′39.1″W, 525 m, old-growth western hemlock-western redcedar forest with *Menziesia ferruginea* and *Oplopanax horridus*, 22 September 2018, on wood, I. Stepanchikova 39-40 (LE) only thallus with soredia and cephalodia; ibid., 55°32′29.8″N/128°01′59.8″W, alt. 621 m, wet mossy old-growth western hemlock-western redcedar forest with *Menziesia ferruginea* and *Oplopanax horridus*, 22 September 2018, on wood of *Thuja plicata*, I. Stepanchikova 41-42 (LE); North Coast, Haida Gwaii, Graham Island, shortly east of Masset, Leitrim Base, 54°1.7′N/132°2.6′W, over moss on driftwood, back-dune near marine shore 6 October 2018, Björk 48291 (UBC); ibid., vicinity of Masset, 54°1′23″N/131°58′35″W, alt. 9 m, western redcedar rainforest with western hemlock, 24 September 2018, on mossy branches and dead root of *Tsuga heterophylla*, I. Stepanchikova 52 (LE); ibid., hilltop, 54°1′21″N/131°58′36″W, alt. 42 m, old-growth western hemlock-western redcedar forest, 24 September 2018, on dead bark of *Tsuga heterophylla*, I. Stepanchikova 54 (LE); ibid., Rennell Sound Bay, Pacific Ocean coast, 53°25′25″N/132°35′29″W, alt. 3 m, old-growth coastal coniferous forest, 25 September 2018, on bark of *Thuja plicata*, I. Stepanchikova 64 (LE).

Additional specimens examined: USA, Oregon, Lane County, on W-sloping ridge just N of Watershed 10, H. J. Andrews Experimental Forest, 44°13.2′N/122°15.5′W, alt. 610 m, mixed-age *Pseudotsuga-Tsuga*, with *Rhododendron* undergrowth, on rotting log, 6 March 2000, B. McCune 25337 (H). Argentina, Rio Negro, km 81 de la carretera 231, cerca del Lago Totoral, al NW del Lago Nahuel Huapi, camino al Paso de Puyehue, cerca de la frontera con Chile, 40°41′S/71°42′W, epifita, comun en bosques humedos de guindos (*Nothofagus dombeyi* Mirb. Oerst.), 21 November 2006, E. Fuertes 7 (H).

Micarea prasina Fr. s. str., Syst. orb.: 256–7. (1825). ≡ *Biatora prasina* Fr., Stirp. agri femsion.: 36. 1825, nom. illeg. (Art. 63). ≡ *Biatora prasina* (Fr.) Trevisan, Linnaea 28: 288. 1856, nec Tuck. & Mont., in Mont. 1857. ≡ *Catillaria prasina* (Fr.) Th.Fr., Lich. Scand. 2: 572. 1874 (Fig. 2H).

Type: Sweden, Småland, Femsjö, on lignum, E. M. Fries (lectotype UPS!; Coppins 1989).

Description of studied specimens: Thallus effuse, granular to warted-granular, bright green to olive green. Apothecia immarginate, brownish to dark brown, 0.20–0.35 mm diam. Epihymenium hyaline or pale grey to darkish grey, sometimes brownish, K+ violet and C+ violet if Sedifolia-grey pigment is present. Hymenium hyaline, 50–7 µm tall (30–60 µm tall according to Launis et al. 2019a). Hypothecium hyaline, 120–150 µm tall. Ascospores 0–1-septate, 10–12 × 3–5 µm. Crystalline granu-

les detected in polarized light always in epihymenium, sometimes crystals were observed in hymenium in the form of vertical streaks and thallus.

Chemistry: HPTLC: micareic acid. Thallus K–, C–. Pale grey or dark grey parts of epihimenium K+ violet, C+ violet.

Note: *Micarea prasina* is the commonest and most variable member of the genus. It was described in 1825, but because of taxonomic uncertainties and variation of diagnostic features still remains a problematic taxon to identify. As a result, the name "*Micarea prasina*" included a large complex of taxa (Coppins 1983, Czarnota 2007) that were later described as separate species (Czarnota 2007, Czarnota & Guzow-Krzemińska 2010, Guzow-Krzemińska et al. 2016, 2019, van den Boom et al. 2017, Launis et al. 2019a, b, Launis & Myllys 2019). *Micarea prasina* s. str. usually has a well-developed granular thallus, numerous hemispherical to sometimes subglobose apothecia, pale grey to partly dark grey, sometimes brownish, and crystalline granules in the epihymenium (Launis et al. 2019a). However, specimens with poorly developed thallus and other coloration of apothecia can be confused with other species containing micareic acid. To date, 11 species of *Micarea* with micareic acid including *M. prasina* s. str. are known in the world. Only three of them are known for North America – *M. fallax*, *M. prasina* s. str. and *M. soralifera*. For differences between species, see *M. fallax* and *M. soralifera*.

Ecology and Distribution: *Micarea prasina* s. str. prefers rotten wood. It is rare on the bark of various tree species. It often occurs in old-growth mixed or coniferous forests near water (e.g., rivers, creeks, waterfalls, sea coasts). World distribution: this is probably one of the most common species of the genus, widely distributed on all continents excluding Antarctica. However, many specimens identified as *M. prasina* in herbaria require revision, as the name was applied more broadly in the past. The specimens cited here are the first confirmed reports of *Micarea prasina* s. str. from Canada.

Specimens examined: Canada, British Columbia, Fraser-Fort George, near McBride, 53°25′27.6″N/120°27′26.0″W, alt. 913 m, western redcedar-spruce forest with feathermosses, margin of clearcut, 18 September 2018, on fallen deadwood, I. Stepanchikova 19 (LE); ibid., 53°26′36.2″N/120°30′56.2″W, alt. 884 m, old-growth western redcedar-western hemlock forest with alder, along the creek, 19 September 2018, on bark of *Thuja plicata*, I. Stepanchikova 31 (LE); ibid., 53°26′35.4″N/120°30′53.7″W, alt. 885 m, old-growth western redcedar-western hemlock forest, 19 September 2018, on *Tsuga heterophylla* deadwood, I. Stepanchikova 32–33 (LE); Kitimat-Stikine, near Kispiox, 55°27′12.1″N/127°51′11.3″W, alt. 511 m, old-growth western hemlock forest, 22 September 2018, on logs and standing deadwood, I. Stepanchikova 37 (LE); ibid., 55°28′34.4″N/127°52′39.1″W, alt. 525 m, old-growth western hemlock-western redcedar forest with *Menziesia ferruginea* and *Oplopanax horridus*, 22 September 2018, on wood, I. Stepanchikova 39-40 (LE); ibid., near Mitten Lake, 55°32′29.8″N/128°01′59.8″W, alt. 621 m, wet mossy old-growth western hemlock-western redcedar forest with *Menziesia ferruginea* and *Oplopanax horridus*, 22 September 2018, on wood, I. Stepanchikova 41-42 (LE); North Coast, Haida Gwaii, Graham Island, vicinity of Masset, hilltop, 54°01′21″N/131°58′36″W, alt. 42 m, old-growth western redcedar-western hemlock forest, 24 September 2018, on deadwood of *Tsuga heterophylla*, I. Stepanchikova 54 (LE); ibid., Rennell Sound Bay, mouth of the river, 50 m to the Pacific Ocean, 53°25′30.7″N/132°35′07.9″W, alt. 9 m, old-growth western hemlock rainforest with pine and spruce, 25 September 2018, on rotten wood, I. Stepanchikova 61 (LE); ibid., near the Yakoun Lake, 53°21′12.8″N/132°16′55.5″W, alt. 112 m, old-growth western redcedar-western hemlock forest, 25 September 2018, on wood, I. Stepanchikova 67 (LE); ibid., Mayer Lake shore, 53°43′30″N/132°2′56″W, alt. 29 m, young cedar forest, 26 September 2018, on wood of *Thuja plicata*, I. Stepanchikova 74 (LE); ibid., 53°44′06.4″N/132°02′59.5″W, alt. 49 m, old-growth western redcedar-western hemlock forest, 26 September 2018, on wood of *Tsuga heterophylla*, I. Stepanchikova 75 (LE); ibid., Kaien Island, vicinity of Prince Rupert, 54°17′36.1″N/130°16′58.4″W, alt. 268 m, western hemlock forest, 28 September 2018, on wood of broken, dead *Tsuga heterophylla*, I. Stepanchikova 80 (LE); Wells Gray Country, near Clearwater, 51°45′40.4″N/119°55′13.1″W, alt. 1502 m, fir trees near the waterfall, 30 September 2018, on wood of *Abies lasiocarpa*, I. Stepanchikova 87a (LE), GenBank voucher MW227663; ibid., I. Stepanchikova 87b (LE), GenBank voucher MW227657. New Brunswick, Charlotte County, Lepreau Falls Provincial Park, next to waterfalls parking area, 45°10′07.0″N/66°28′11.6″W, alt. ca. 100 m, in moist conifer forest by the falls, 6 September 2014, T. Ahti 74382 & S. R. Clayden (H). Newfoundland & Labrador, Island of Newfoundland, Gros Morne National Park, Lomond S, Killdevil Camp, 49°27′N/57°45′W, alt. 25 m, 14 September 2014, on stump, T. Ahti 74703a (H); ibid., St. Barbe District, Bryants Raft Pond, 18 km SSE of Hawke's Bay, 50°33′06″N/57°10′16″W, alt. 60 m, on *Picea mariana* Britton, Sterns & Poggenb in mesic *Abies balsamea* (L.) Mill. forest, scarce, 24 July 2000, on stump, T. Ahti 59790 (H).

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