

## *Micarea subalpina* Coppins & Spribille, a new subalpine species from the Rocky Mountains, USA

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**Abstract:** *Micarea subalpina* sp. nov. is described from plant detritus in subalpine forest parkland in the mountains of western Montana (USA). It has similarities to *M. assimilata* and *M. erratica*.

**Key words:** *Micareaaceae*, Montana, *Pinus albicaulis* forest, subalpine forest parkland, terricolous lichens, USA

### Introduction

During the past eight years, the second author has been occupied with the phytosociological study of the forests of a portion of the northern Rocky Mountains in Montana (USA). Already in 1994, a crustose lichen that could not be readily assigned to any known species was encountered growing on bare mineral soil in a subalpine forest. The specimen was determined at that time by the first author to represent a new species in the genus *Micarea* Fr., but as only limited material was available, the samples were put away for further study. Since then, the species has been found to be common in high elevation snow forests of *Abies lasiocarpa* and *Pinus albicaulis* in parts of western Montana. The further study of forest communities has revealed that the species is almost completely restricted to one forest association. Here, we describe the species and the habitats in which it is found.

### Materials and Methods

Microscopical measurements of ascospores, paraphyses, hyphae and conidia were made at  $\times 1000$  magnification in 10% KOH; other measurements were made in water. Ascospore measurements in the description of the new species are given as (minimum value observed)  $[M - SD] - M - [M + SD]$  (maximum value observed), where M=mean value, and SD=standard deviation ( $n=50$ ).

### The Species

#### *Micarea subalpina* Coppins & Spribille sp. nov.

*A. M. assimilata* (Nyl.) Coppins thallo continuo, cellulis algae grandioribus, cephalodiis destitutis, apotheciis parvioribus, ascosporis brevioribus praecipue dignoscenda; differt a *M. erratica* (Körb.) Hertel, Rambold & Pietschm. apotheciis immarginatis, magis convexis et grandioribus, et ascosporis longioribus, et a *M. melanida* cellulis algae grandioribus et ascosporis simplicibus (haud 1-septatis).

Typus: USA, Montana, Lincoln County, Whitefish Range, Clarence Creek drainage, along hiking trail to Mt. Wam, 300–500 m S of saddle crossing into the Rich Creek drainage, 48°56'30"N 114°49'35"W, frequent on soil and plant detritus on edge of hiking trail through the forest association *Menziesio-Abietetum bifoliae*, E-facing slope, 1890 m alt., 17 July 2001, T. Spribille & D. La Velle 11074 (CANL—holotypus; COLO, E, GOET, US—isotypi).

(Figs 1–3)

*Thallus* effuse, grey-white, grey-green, or pale greenish grey to medium grey, matt,

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FIG. 1. *Micarea subalpina* (Spribille 12418), habitus. Scale=1 mm.

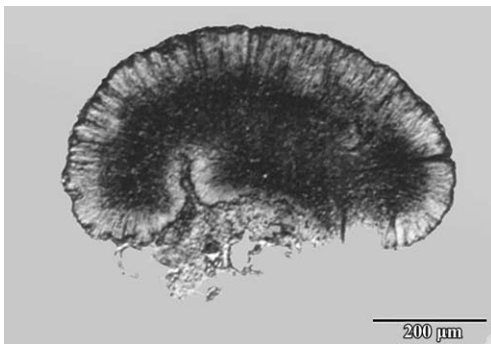


FIG. 2. *Micarea subalpina* (Spribille 12418), section of apothecium. Scale=200  $\mu\text{m}$ .

continuous, uneven (owing to texture of substratum) but never with discrete verrucae, areoles or granules; soredia and isidia absent; prothallus not observed; cephalodia absent. In section, thallus *c.* 100–300  $\mu\text{m}$  thick, without a cortex but often with a hyaline epinecral layer 5–10  $\mu\text{m}$  thick; when thallus medium grey, some hyphae in upper part of algal layer surrounded in dull olivaceous pigment, N+ red. *Photobiont* cells not ‘micareoid’ (sensu Coppins 1983), globose, 7–10(–12)  $\mu\text{m}$  diam., or irregularly ellipsoid and to 12–13  $\times$  8–9.5  $\mu\text{m}$ .

*Apothecia* numerous, separate or often several becoming confluent, black, or reddish brown in shaded niches, matt, convex-hemispherical to subglobose, immarginate, often constricted below, 0.22–0.5(–0.6) mm diam., or occasionally tuberculate and to

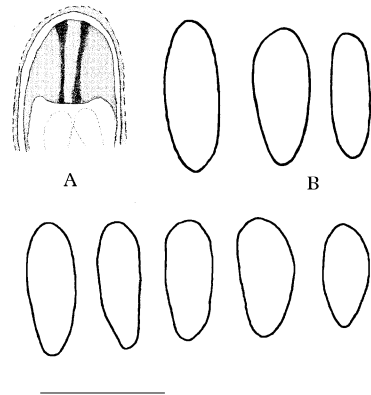


FIG. 3. *Micarea subalpina* (isotype in E). A, ascus tip in Lugol's iodine after pretreatment with 10% KOH; B, ascospores. Scale=10  $\mu\text{m}$ .

0.7 mm diam. *Hymenium* 35–55  $\mu\text{m}$  tall, hyaline, or dilute reddish brown (especially in lower part) or dilute olivaceous in upper part, I+ blue; *epithecium* *c.* 2–5  $\mu\text{m}$  tall, with dense, dark sordid olivaceous pigment, K – or K+ slightly green intensifying, N+ red. *Paraphyses* numerous, simple or sparingly branched (especially near apices), 2–3(–4)-septate, 1–1.5(–1.8)  $\mu\text{m}$  wide in mid-hymenium, not or only slightly incrassate above to 2  $\mu\text{m}$ . *Asci* clavate, 36–40  $\times$  10.5–12  $\mu\text{m}$ , 8-spored; in K/I with an amyloid apical dome and a darker blue, axial tube. *Ascospores* simple, narrowly ellipsoid to ovoid-ellipsoid, (7.7–)9.5–10.7–11.8(–12.5)  $\times$  (3.4–)3.7–4.0–4.3(–4.7)  $\mu\text{m}$ ; length/breadth ratio (1.7–)2.4–2.7–3.0(–3.3). *Hypothecium* 70–110(–170)  $\mu\text{m}$  tall, mostly dark reddish brown, sometimes with a purplish tinge, K – or K+ faintly purplish intensifying, N+ reddish intensifying, but upper 12–50  $\mu\text{m}$  often appearing less darkly pigmented and mottled; I –; hyphae interwoven but outwardly orientated in outer part, *c.* 1.2–1.8  $\mu\text{m}$  wide; ascogenous hyphae, short-celled, *c.* 2–4  $\mu\text{m}$  wide. *Exciple* distinct, especially in young apothecia, as a reflexed, I –, *c.* 25–30  $\mu\text{m}$  wide, dilute reddish-brown zone, sometimes with a 2–4  $\mu\text{m}$  wide, dark reddish brown outer zone; hyphae outwardly radiating, branched, 1.5–1.8  $\mu\text{m}$  wide.

*Pycnidia* few or absent, semi-immersed in the thallus, 70–100 µm diam., black, with gaping ostiole; wall reddish brown, but dark sordid greenish around the ostiole. *Conidia* (?microconidia) bacilliform, or slightly broader towards the proximal end, 4.3–5 × 1–1.2 µm.

**Chemistry.** Apothecial sections C –; thallus K –, C –, KC –, PD –; no substances detected by TLC. Greenish pigment in upper part of thallus (when present), epithecium and ostiolar region of pycnidia K – or K+ faintly greenish intensifying, N+ red. Reddish brown pigment of hypothecium, exciple and pycnidial wall, K –, N –, or (in hypothecium) K+ faintly purplish, N+ faintly reddish.

**Etymology.** The epithet *subalpina* refers to the occurrence of this species in the open subalpine parklands and krummholz of the northern Rocky Mountains as described by Peet (2000) and Stachurska-Swakoń & Spribille (2003).

**Remarks.** In its character traits, *M. subalpina* is intermediate between the terricolous *M. assimilata* (Nyl.) Coppins and the mainly saxicolous *M. erratica* (Körb.) Hertel, Rambold & Pietschm. The former differs in having distinct areoles, cephalodia, a ‘micareoid’ photobiont, larger apothecia, larger ascospores and a more distinctly K+ purple hypothecium. The latter mainly differs in having smaller apothecia that are flatter and shallowly marginate (at least when young), shorter ascospores, and a different substratum ecology (Table 1). Very similar to *M. erratica*, but with a ‘micareoid’ photobiont is the saxicolous *M. lapillicola* (Vain.) Coppins & Muhr (Coppins & Muhr 1997). Also comparable with *M. subalpina* is *M. incrassata* Hedl., which resembles *M. assimilata* in having an areolate thallus with cephalodia and larger apothecia, but lacks any purplish pigmentation in the hypothecium. However, it differs from both *M. assimilata* and *M. subalpina* in having a generally darker, often brownish coloured thallus, and a higher proportion of 1-septate

ascospores (Coppins 1983). The saxicolous *M. subconfusa* (Nyl.) Alstrup, from the British Isles and the Faroe Islands, is again similar, but differs from *M. subalpina* in its granular-areolate thallus, ‘micareoid’ photobiont (and weakly formed cephalodia with *Stigonema*), and smaller ascospores [Coppins 1992: 381, as *M. submoestula* (Nyl.) Coppins]. The widely distributed (Europe, South Africa and Australia), terricolous *M. melaenida* (Nyl.) Coppins (1983; Table 1) inhabits sandy or argillaceous soils and is possibly closely related to *M. subalpina*, but has a ‘micareoid’ photobiont, and a high proportion of 1-septate ascospores. *Micarea turfosa* (A. Massal.) Du Rietz has a similar terricolous habit and hypothecial pigmentation to *M. subalpina*, but has a dark, often blackish thallus and larger, 0–3-septate ascospores (Table 1). In the field, *M. subalpina* can superficially resemble several, taxonomically unrelated, arctic-alpine terricolous lichens that have blackish, more or less convex apothecia and a pale grey thallus, for example *Buellia papillata* (Sommerf.) Tuck., *Catillaria contristans* (Nyl.) Zahlbr., *Lecidella wulfenii* (Hepp) Körb., *Myxobilimbia lobulata* (Sommerf.) Hafellner, *Protomicarea limosa* (Ach.) Hafellner, and members of the *Lecidea* (*Mycobilimbia*) *hypnorum* group [especially *L. berengeriana* (A. Massal.) Nyl.]

**Distribution and habitat.** *Micarea subalpina* is found at a series of sites concentrated in the Whitefish Range of north-western Montana (49°N), southwards to the Lewis and Clark Range (47°N). At nearly all of its known sites it was found on plant detritus or bare mineral soil in subalpine snow forests of *Abies lasiocarpa* and *Pinus albicaulis*, in which the large liliaceous sclerophyte *Xerophyllum tenax* completely dominates the herb layer. A recent phytosociological study (Stachurska-Swakoń & Spribille 2002), which included the habitats of *M. subalpina*, provides an overview of the distributional tendencies of the species within subalpine forest communities. Almost all of the known sites for *M. subalpina* are in the association *Xerophyllo-Pinetum albicaulis*, a community

TABLE 1. Comparison of *Micarea subalpina* with some similar species

	<i>M. assimilata</i>	<i>M. erratica</i>	<i>M. incrassata</i>	<i>M. melaenida</i>	<i>M. subalpina</i>	<i>M. subconfusa</i>	<i>M. turfosa</i>
Thallus texture	areolate	continuous	areolate	continuous to areolate	continuous	granular areolate	continuous
colour	white to brownish white	medium to dark grey	grey-white, grey-brown to dark grey	dull greenish white	grey-white, pale greenish grey to medium grey	dark grey	grey-green, blackish grey or brown-black
cephalodia	present	absent	present	absent	absent	± present	absent
Photobiont diam. (µm)	'micareoid' 4-7	non-'micareoid' 7-16(26)	'micareoid' 4-7	'micareoid' 4-7	non-'micareoid' 7-10(12)	'micareoid' 4-7	'micareoid' 4-7
Apothecia margination	immarginate	marginate when young	immarginate	immarginate	immarginate	immarginate	immarginate
diam. (mm)	0.3-0.8	(0.15)0.2-0.4(0.7)	0.3-0.8(1.0)	0.2-0.6	0.2-0.5(0.46)	0.3-0.7	0.15-0.3(0.4)
Hypothecium	dark purple-brown, K+ purple or (in upper part) K+ green	dark reddish brown, K -	dark reddish brown, K -	mottled dark purple-brown, K ± purple	dark reddish brown, K - or K+f purplish	dark reddish brown, K -	dark mottled reddish brown, K -
Ascospores septation	0(1)	0	0-1(2)	0-1	0	0(1)	0-3
length (µm)*	(10-)12-16(-19)	(6-)7-9(-10)	(10-)12-17	(7-)9-15	(8-)9-12(-13)	(6-)7-10	(10-)12-21(-25)
width (µm)	3-5	(2-)3-4(-5)	4-4.8	3-4(-4.5)	3.7-4.3(-4.7)	2.5-3.5	(3.5-)4-5
Conidia (µm)	6-9 × 1-1.5	3-4.5 × 1.2-1.8	6-9 × 1-1.3	4.8-6(7) × 1	4.3-5 × 1-1.2	4-6 × 1-1.6	c. 3.5-4.7 × 1
Substrata	terricolous	saxicolous or lignicolous	terricolous	terricolous	terricolous	saxicolous	terricolous

\*Adjusted to nearest whole number.

of relatively dry, well drained sites on south to west facing slopes and ridges. The vascular plant composition is species-poor and dominated by *X. tenax* and *Arnica latifolia*. A noteworthy feature of the association *Xerophyllo-Pinetum albicaulis* is the mass die-back of *Pinus albicaulis* due to the unchecked spread of the introduced Eurasian white pine blister rust *Cronartium ribicola* (Keane & Arno 1993). However, there are no observations to suggest that this has significantly affected the microsites in which *M. subalpina* occurs. More rarely, the species has also been found in the moister, more strongly chionophilous associations *Luzulo-Abietetum bifoliae* and *Menziesio-Abietetum bifoliae* in subalpine cirque basins which interdigitate with the ridges on which *Xerophyllo-Pinetum albicaulis* is the dominant community (Stachurska-Swakoń & Spribille 2002). Elevations range from 1800 and 2300 m. The geological bedrock is usually calcium-poor argillite and quartzite. A unique feature of these habitats, and one which doubtless narrows the pool of species able to compete, is the extreme moisture gradient in the course of the year. Winter snowpacks are deep (frequently 1.5–2 m) and persist seven to nine months. Snowmelt is followed by a period of low summer precipitation, leaving the habitats where *M. subalpina* is found desiccated by mid-August. The brief, dry summer is followed by autumn rains which quickly turn to snow as early as October.

The habitats of *M. subalpina* are not usually cryptogam-rich. Associated lichens typically include *Cladonia chlorophaea*, *Lecidea berengeriana*, *Placynthiella uliginosa* and *Trapeliopsis granulosa*. The associated bryophyte flora includes common subalpine, often ruderal species, such as *Bryum caespiticium* s.lat., *Ceratodon purpureus*, *Desmatodon latifolius* and *Pohlia nutans*.

*Additional specimens examined.* **USA:** Montana: Flathead County, Whitefish Range, 0.8 km SW of Standard Peak, just below unnamed summit, UTM Z11 E7028 N537934, 2135 m, in subalpine *Pinus albicaulis* forest, 1994, T. Spribille (E); Lewis and Clark County, Lewis and Clark Range, c. 12 km N of town of Lincoln, Cotter Creek drainage headwall, c. 47°05'N 112°40'W, c. 2300 m, in *Xerophyllum* lawns over argillitic (non-calcareous) bedrock on N-facing slope,

relatively late-lying snow area, krummholz zone, 4 x 1997, T. Spribille (E); Lincoln County, Whitefish Range, Ten Lakes Scenic Area, S-facing slope of Rainbow Lake, c. 48°58'30"N 114°53'00"W, 2137 m, in subalpine *Xerophyllum tenax-Abies lasiocarpa-Pinus albicaulis* parkland, 30 vii 1999, A. Stachurska & T. Spribille (COLO); *ibid.*, 2147 m (COLO); *ibid.* 2184 m (COLO); *ibid.*, 1962 m, 2 viii 1999 (COLO); *ibid.*, 2044 m (COLO); *ibid.*, Bluebird Basin, c. 48°56'40"N 114°55'50"W, 2085 m, in chionophilous subalpine *Luzula hitchcockii-Abies lasiocarpa* forest parkland, 4 viii 1999, A. Stachurska & T. Spribille (COLO); *ibid.*, 2145 m, 5 viii 1999 (COLO); *ibid.*, trail to Bluebird Lake, c. 48°56'40"N 114°55'50"W, 1910 m, in subalpine forest parkland, 4 viii 1999, A. Stachurska & T. Spribille (COLO); Bluebird Lake trail, soil on edge of trail in stand of *Xerophyllo-Pinetum albicaulis* on small ridge, c. 2000 m, 2002, T. Spribille 12418 (COLO, UBC); *ibid.*, Baboon Lake, 48°53'45"N 114°51'30"W, 2080 m, in subalpine forest parkland, 4 viii 1999, A. Stachurska & J. Triepke (COLO); *ibid.* Wolverine Lake, 48°58'10"N 114°55'20"W, 2091 m, in subalpine forest parkland, 23 viii 1999, A. Stachurska & T. Spribille (COLO); Whitefish Range, Grave Creek watershed, high ridge between Williams and Kopsi Creeks, 48°51'30"N 114°45'30"W, 1935 m, in subalpine *Xerophyllum tenax-Pinus albicaulis* forest parkland, 13 viii 1999, T. Spribille & C. Ferruzzi (COLO); *ibid.*, 2116 m (COLO); *ibid.*, Drip Creek cirque, c. 48°55'50"N 114°46'50"W, 1928 m, in chionophilous subalpine forest parkland, 13 viii 1999, A. Stachurska & J. Triepke (COLO); Whitefish Range, ridge between Clarence and Rich Creeks, N of Stahl Peak, ENE of Big Therriault Lake, 48°56'30"N 114°50'30"W, 1929 m, in open subalpine *Xerophyllum tenax-Abies lasiocarpa-Pinus albicaulis* forest parkland, 24 viii 1999, A. Stachurska & T. Spribille (COLO); *ibid.*, 1975 m (COLO); Whitefish Range, ridge N of Divide Creek, c. 48°58'00"N 114°45'00"W, 1808 m, in open subalpine forest parkland, 25 viii 1999, A. Stachurska & J. Triepke (COLO).

Thanks are extended to Alina Stachurska-Swakoń (Krakow, Poland) and Jack Triepke (Eureka, Montana) for help with mapping this species in the summer of 1999, and to Rob Carlin and Ed Monnig of the Kootenai National Forest, Fortine Ranger District, for supporting detailed floristic inventory in northwestern Montana.

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*Accepted for publication 10 December 2003*