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MICAREA CONTEXTA AND *M. LYNCEOLA* (LICHENIZED ASCOMYCOTA), NEW FOR POLAND

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Abstract. Endoxylic *Micarea contexta* Hedl. and epilithic *M. lynceola* (Th. Fr.) Palice are presented as lichenized fungi new for Poland and the Carpathians. Their phenotypic characters and affinities to other *Micarea* species, their world distribution and ecological preferences are given, with an updated key for all members of *Micarea* s.l. found in Poland.

Key words: lichens, lichenized fungi, Tatra Mts, Babia Góra National Park, Western Carpathians

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Recent molecular studies have shown that the lichen genus *Micarea* Fr. (Pilocarpaceae, Ascomycota) is not monophyletic but contains several well-supported groups nested within Pilocarpaceae and Psoraceae (Andersen & Ekman 2005). Phylogenetically, the *Micarea sylvicola* group, including *M. bauschiana* (Körber) V. Wirth & Vězda, *M. lutulata* (Nyl.) Coppins, *M. sylvicola* (Flotow) Vězda & V. Wirth and *M. tuberculata* (Sommerf.) R. Anderson, is distantly related to the type of the genus, *Micarea prasina* Fr., and probably should be transferred to another genus within Psoraceae. No nomenclatural innovations have been undertaken to date, other than a recent proposal to transfer the lecideoid *Micarea erratica* (Körber) Hertel, Rambold & Pietschm. associated with a large-celled photobiont to the new genus *Leimonis* (Harris 2009).

Infrageneric groups and many individual representatives of the genus *Micarea* do not share uniform phenotypic or chemical features (Coppins 1983). Several species mostly related to *M. prasina* Fr. are characterized by their 'micareoid' photobiont, more or less anastomosed paraphyses, *Micarea*-type asci, strongly reduced or absent excipulum, single or 1-septate ascospores, and hyaline, usually colorless apothecial section, sometimes covered with Sedifolia-grey pigment (Czarnota 2007). Many other species have a strongly developed excipulum [e.g., *Micarea marginata* Coppins & Muhr, *M. paratropa* (Nyl.) Alstrup, *M. peliocarpa* (Anzi) Coppins & R. Sant.], large-celled photobionts [e.g., members of *Micarea sylvicola* group, *M. erratica* (Körb.) Hertel, Rambold & Pietschm., *M. polycarpella* (Erichsen) Coppins & Palice], densely pigmented hypothecium [e.g., *M. botryoides* (Nyl.) Coppins, *M. deminuta* Coppins, *M. nigella* Coppins] and different size and septation of ascospores [e.g., *M. lignaria* (Ach.) Hedl., *M. myriocarpa* V. Wirth & Vězda, *M. nitschkeana* (Lahm. ex Rabenh.) Harm., *M. turfosa* (Massal.) Du Rietz]. The ecological preferences of *Micarea* taxa also vary greatly: some grow directly on rocks or different kinds of rotten wood and soil, and others are epiphytes or epibryophytes. This makes correct identification of a new member of *Micarea* more complicated than in many other genera of lichenized fungi, and requires more experience.

A recently published monograph on *Micarea* in Poland (Czarnota 2007) includes 34 species; further taxa recorded in the neighboring Czech Republic (Liška *et al*. 2008) were also considered as occurring there. Two of these, *M. contexta* Hedl. and M. *lynceola* (Th. Fr.) Palice, have indeed been discovered recently in the Polish Carpathians during intensive lichenological explorations, and

are presented here as new to this country and to this mountain range.

Neither taxa is closely related to *M. prasina*, differing in having dull apothecial pigmentation in the case of *M. contexta* and in having a well developed excipulum, large-celled photobiont, and persistently simple ascospores in *M. lynceola*. The distant phylogenetic relationship of *M. lynceola* to the 'core' group of *M. prasina* was confirmed by analyses of mtSSU rDNA sequences (Andersen & Ekman 2005). *Micarea contexta* has not been sequenced, so its relationship within the genus *Micarea* is based only on phenotypic similarities (for details see Coppins 1983).

This paper briefly characterizes *M. contexta* and *M. lynceola*, focusing mainly on their ecological preferences and world distribution. Photographs showing morphological and anatomical features of both species are presented here for the first time in the literature. Standard identification methods were used and the examined materials are deposited in the herbarium of Gorce National Park (GPN).

Micarea contexta Hedl. Fig. 1

Bih. K. Svenska Vetensk. Akad. Handl. III. **18**(3): 83, 96. 1892.

Thallus endoxylic, inconspicuous. Photobiont 'micareoid', cells 5–7 µm diam. Apothecia subglobose, immarginate from the start, black, very small, 0.1–0.2 mm. Upper part of hymenium and vertical streaks dull green, hypothecium purple-green, K+ green intensifying. Paraphyses of two types: (1) less than 1 µm wide, hyaline, sometimes branched and anastomosing, and (2) 1.5–2.0 µm wide, apices widening to 3 µm and usually pigmented, aggregated in vertical streaks. Ascospores 1-septate, oblong to ovoid, 7–12 × 3.0–4.5 µm (for more details see Coppins 1983).

AFFINITIES. Coppins (1983) and Palice (1999) paid more attention to the similarity of *Micarea contexta* to immature forms of *M. melaena*. Considering its ecological preferences, indistinct thallus, diminutive size and black apothecia, as well as apothecial purple-green internal pigmentation which turns green in K, *M. contexta* greatly resembles *M. nigella*; the two species can only be distinguished by the septation of ascospores, which are persistently 1-septate in *M. contexta* and simple

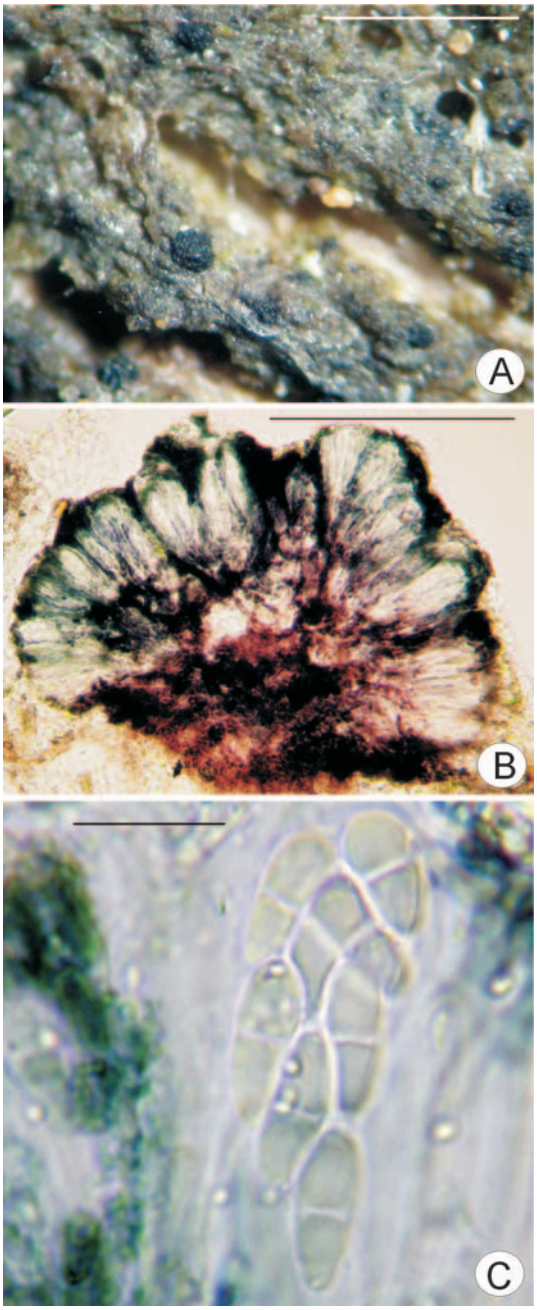

Fig. 1. *Micarea contexta* Hedl. A – habit, B – apothecial cross section, C – ascospores (*P. Czarnota 7016*, GPN). Scale bars: A = 1 mm, B = 100 µm, C = 10 µm.

in *M. nigella*, and the presence of stalked pycnidia in *M. nigella*, which are absent in *M. contexta*.

DISTRIBUTION AND ECOLOGY. *Micarea contexta* is reported rarely from several European countries, mostly from central Sweden and Scotland (Coppins 1983, 2009; Perhans *et al*. 2007) and from single localities in Switzerland (Groner 2006) and the Czech Republic (Palice 1999); there are also reports from the northern part of European Russia and the Ural Mts (Urbanavichus 2010). Here it is reported as new for Poland and the Carpathians.

The collection of *M. contexta* presented here was taken in the Tatra Mts, in the upper forest belt covered with Norway spruce forest *Plagiothecio-Piceetum*, close to the timber line. It was associated with *Micarea anterior* (Nyl.) Hedl., *Psoroglaena abscondita* (Coppins & Vězda) Hafellner & Türk and *Xylographa vitiligo* (Ach.) J. R. Laundon, all of which are rarely recorded in Poland. *Micarea contexta* prefers boreal or montane coniferous forests, where it is found on conifer lignum in different states of decomposition. For this reason, potentially it is more frequent in deadwood-rich Carpathian forests, which are strictly protected in a large area of the mountains. Considering the diminutive apothecia and inconspicuous endoxylic thallus, the species most probably has been overlooked.

SPECIMEN EXAMINED. POLAND. TATRA MTS: Tatra National Park, forest section 261h, Tomanowa Dolina valley, Zadni Smreczyński Grzbiet area, alt. 1420 m, 49°13′13.3″N, 19°53′04.3″E (ATPOL grid square Gd 59); on decaying wood of decorticated *Picea abies* trunk, 3 Apr. 2010, *P. Czarnota 7016* (GPN).

Micarea lynceola (Th. Fr.) Palice Fig. 2

Preslia **71**: 313. 1999.

Thallus epilithic, very thin, inconspicuous, effuse, pale buff. Photobiont large-celled, globose, up to 20 µm diam. Apothecia numerous, black, slightly convex, usually immarginate, 0.2–0.4 mm diam. Apothecial section hyaline, but upper part of hymenium and outer edge of excipulum slightly bluish green, aeruginose or olivaceous, K–. Excipulum well-developed, composed of radiating and branched hyphae. Paraphyses monomorphic, sparsely branched, only slightly widening towards apices. Ascospores simple, ovoid, 7–9 × 3–4 µm wide (for more details see Coppins 1988).

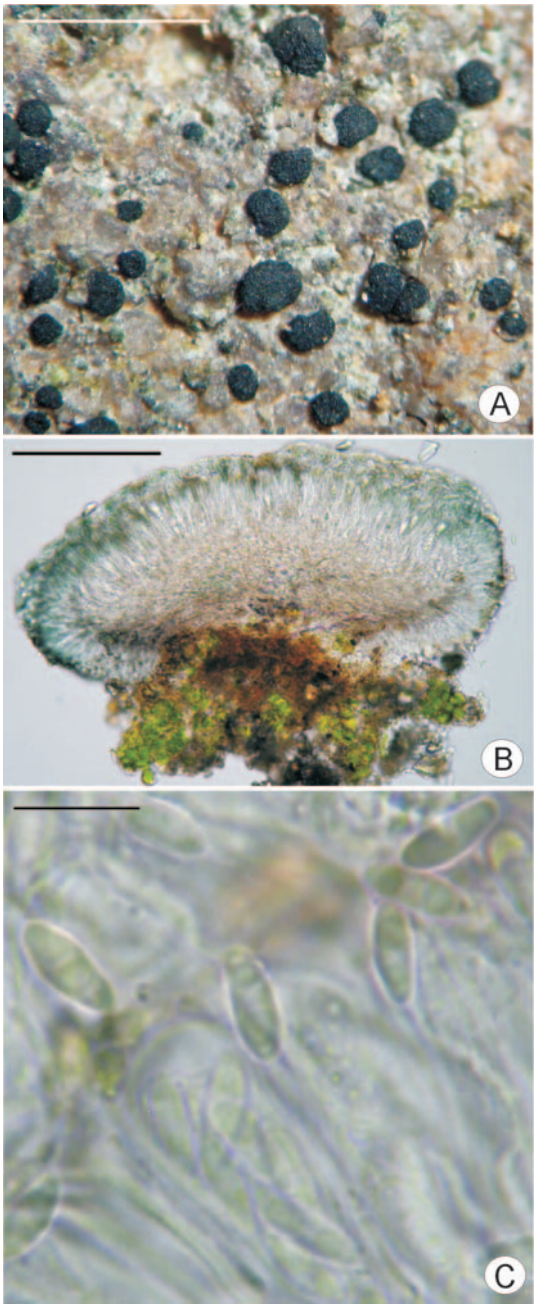

Fig. 2. *Micarea lynceola* (Th. Fr.) Palice. A – habit, B – apothecial cross section, C – ascospores (*P. Czarnota 6338*, GPN). Scale bars: A = 1 mm, B = 100 µm, C = 10 µm.

AFFINITIES. *Micarea lynceola* mostly resembles *M. bauchsiana* and *M. polycarpella* by its blue-green apothecial pigmentation (confined to upper part of hymenium), simple, ovoid ascospores and large-celled photobiont. It differs from both in its well-developed excipulum. Details on the similarities and differences of all three species are found in Coppins (1988) and Palice (1999).

DISTRIBUTION AND ECOLOGY. *Micarea lynceola* is a widespread but rarely reported European species. Since the most recent world distribution was published by Palice (1999), it has been found in Belgium (Ertz *et al*. 2008), the Netherlands (Aptroot & van Herk 1999; Spier 2000) and the Russian part of Lapponia (Urbanavichus *et al*. 2008); it has also been reported from North America (Lowe 1939, as *Lecidea lynceola*), but considering its former misidentification with *M. bauschiana*, its true North American distribution requires verification (see also Coppins & Fryday 2006). New to Poland, and presumably also to the whole Carpathians.

In the literature, *M. lynceola* is shown as an early lichen colonizer occupying loose siliceous pebbles and stones (Palice 1999). In the Carpathians it was also found on small sandstone pebbles in a spruce wind-throw. Associated pioneer species include *Baeomyces rufus* (Huds.) Rebent., *Micarea lithinella* (Nyl.) Hedl., *Porpidia crustulata* (Ach.) Hertel & Knoph, *Thelocarpon lichenicola* (Fuckel) Poelt & Hafellner and *Trapelia coarctata* (Turner ex Sm.) M. Choisy. Interestingly, this new record is in an old-growth upper montane spruce forest close to the timberline, while in other cases *M. lynceola* has rather been found at ruderal sites (e.g., Coppins 2009). Although many other wind-throws in the Polish Western Carpathians were explored recently, the species has not been recorded elsewhere.

SPECIMEN EXAMINED. POLAND. WESTERN BESKIDY MTS: Babia Góra Massif, Babia Góra National Park, forest section 25c, SE slope of Kępa Mt., alt. 1360 m, 49°34′29.4″N, 19°33′41.3″E (ATPOL grid square Gd 27); on sandstone pebbles over root system of fallen *Picea abies* within upper montane spruce forest, 26 Aug. 2009, *P. Czarnota 6338* (GPN).

UPDATED KEY FOR SPECIES OF THE POLISH *MICAREA* S.L.

1. Thallus or apothecia C+ red, photobiont 'micareoid' 2
1*. Thallus and apothecia C– 11
2. Thallus ash-grey, fragile, granular areolate, often dissolving to form sorediate patches, Pd+ ginger or yellow; usually sterile, on decaying bryophytes in high mountains 3
2*. Thallus Pd–, only gyrophoric acid 4
3. Thallus Pd+ yellow (alectorialic acid) . . . . . ***M. submilliaria*** (Nyl.) Coppins
3*. Thallus Pd+ ginger (gyrophoric acid and argopsin) . . . . ***M. leprosula*** (Th. Fr.) Coppins & A. Fletcher
4. Thallus at least partially sorediate 5
4*. Thallus never sorediate, mostly granular or forming small areolae 6
5. Thallus bright green, ±leprosae . . . . . ***M. viridileprosa*** Coppins & van den Boom
5*. Thallus ash-grey to straw-coloured, composed of fragile granules dissolving to form sorediate patches; on terricolous bryophytes . . . . . ***M. leprosula*** II chemotype
6. Hypothecium dark purplish-black, K+ black-green or sometimes with intensive purplish tinge . . . . ***M. melaena*** (Nyl.) Hedl.
6*. Hypothecium hyaline 7
7. Excipulum well developed, upper part of hymenium never K+ violet 8
7*. Excipulum indistinct or absent, epithecium K+ violet 9
8. Spores (1–)3-septate, macroconidia curved or sigmoid, to 50(60) µm length . . . . . ***M. peliocarpa*** (Anzi) Coppins & R. Sant.
8*. Spores (3–)5–7-septate, macroconidia filiform, ±straight, up to 110 µm length . . . . . ***M. cinerea*** (Schaer.) Hedl.
9. Spores (0–)1-septate, oblong-ellipsoid, oblong-fusiform, often slightly curved . . . . . ***M. denigrata*** (Fr.) Hedl.
9*. Spores mostly 3-septate or more. 10
10. Spores 0–3(–5)-septate, fusiform-acicular or rod-shaped, sometimes slightly sigmoid-curved and up to 25 µm in length . . . . . ***M. globulosella*** (Nyl.) Coppins
10*. Spores (1–)3-septate, narrowly fusiform, often slightly sickle-shaped and up to 18 µm in length; usually on twigs and branches of young coniferous trees . . . . . ***M. nitschkeana*** (Lahm *ex* Rabenh.) Harm.

11. Thallus mostly superficially developed, Pd+ ginger (argopsin); spores 3–7-septate . . . . . ***M. lignaria*** (Ach.) Hedl. var. ***lignaria***

11*. Thallus Pd– or thallus thin, inconspicuous or invisible 12

12. Photobiont not 'micareoid', cells more than 10 µm wide; spores simple, ovoid or ellipsoid; on rocks 13

12*. Photobiont 'micareoid', cells 5–8 µm; on different substrates 19

13. Hypothecium dark coloured 14

13*. Hypothecium hyaline 17

14. Excipulum well developed, inner part of excipulum hyaline; apothecia at first plane, marginate, black; hypothecium dark brown . . . . . ***M. erratica*** (Körb.) Hertel, Rambold & Pietschm. [= *Leimonis erratica* (Körb.) Harris]

14*. Excipulum not seen even in young apothecia, which are convex from the beginning 15

15. Hypothecium dark brown, K+ brown intensifying . . . . . ***M. lutulata*** (Nyl.) Coppins

15*. Hypothecium dark aeruginose, sometimes with purplish tinge, K+ green intensifying; apothecia convex, immarginate 16

16. Spores ovoid or ellipsoid, at least 3.0 µm wide . . . . . ***M. sylvicola*** (Flot.) Vězda & V. Wirth

16*. Spores oblong-ellipsoid or oblong-ovoid, 1.5–2.5 µm wide . . . . . ***M. tuberculata*** (Sommerf.) R. A. Anderson

17. Excipulum absent; apothecia immarginate, whitish-grey, greyish, brownish-grey, blackish to black; upper hymenium hyaline or greenish . . . . . ***M. bauschiana*** (Körb.) V. Wirth & Vězda

17*. Excipulum developed; apothecia persistently black 18

18. Excipulum thin, grey; upper hymenium blue; apothecia small 0.1–0.2 mm . . . . . ***M. polycarpella*** (Erichsen) Coppins & Palice

18*. Excipulum thick, hyaline except outer edge concoloured with the olive upper hymenium . . . . . ***M. lynceola*** (Th. Fr.) Palice

19. Hypothecium dark coloured 20

19*. Hypothecium pale or hyaline 27

20. Hypothecium dark purplish-brown or with aeruginose tinge, K+ blackish-green or purplish intensifying 21

20*. Hypothecium brown, K± intensifying; apothecia without visible excipulum 23

21. Pycnidia conspicuous, black, stalked, producing mesoconidia; apothecia convex from the start; excipulum not visible even in young apothecia; spores simple; on lignum . . . . . ***M. nigella*** Coppins

21*. Pycnidia inconspicuous, never stalked 22

22. Apothecia at first marginate, often clustered; excipulum dark coloured, distinctly developed; spores 0–1(2)-septate; on rocks in high mountains . . . . . ***M. marginata*** Coppins & Muhr

22*. Apothecia immarginate, very small, simple; excipulum absent; spores 1-septate; thallus inconspicuous, edosubstratal; on lignum . . . . . ***M. contexta*** Hedl.

23. Thallus pale grey-straw, densely warted to convex areolate, with intermixed brownish cephalodia containing cyanobacteria; spores 0–1(–2)-septate; in high mountains . . . . . ***M. incrassata*** Hedl.

23*. Thallus not warted or areolate, green, blackish or inconspicuous, never with cephalodia 24

24. Pycnidia distinctly stalked, black; pycnidial walls dull olivaceous K± intensifying, fuscous at the base, K– or K± intensifying; thallus green to dull olive-green, continuous or scurfy granular, often without apothecia; ascospores 0–1-septate . . . . . ***M. botryoides*** (Nyl.) Coppins

24*. Pycnidia sessile or inconspicuous, if stalked than not distinctly 25

25. Thallus meally to minutely granular, bright to whitish-green; apothecia pale brown to brown-black, 0.1–0.2 µm wide and mostly tuberculate; ascospores small, oblong, up to 2.5 µm wide; pycnidia sessile; usually on rocks . . . . . ***M. myriocarpa*** V. Wirth & Vězda *ex* Coppins

25*. Thallus not meally or minutely granular; apothecia persistently black and ascospores wider than 3.0 µm 26

26. Thallus inconspicuous, mostly endosubstratal; ascospores simple, up to 10(–11) µm in length; in high mountains . . . . ***M. deminuta*** Coppins

26*. Thallus blackish, ascospores simple or 1–3-septate, more than 10 µm length; on turf and exposed soil in high mountains . . . . . ***M. turfosa*** (A. Massal.) Du Rietz

27. Hymenium in upper part or vertical streaks inside hymenium dull olive-grey, olive-brown, or straw-brown, K+ violet, C+ violet, at least in darker apothecia 28

27*. Hymenium colourless without distinct epithecium, never K+ violet or upper part of hymenium brownish, K–, dulling or dissolving 34

28. Ascospores road-shaped, narrowly fusiform, 1–3(–5)-septate; thallus of dull grey-olivaceous

discrete granular-areolae; no substances detected by TLC .... ***M. synotheoides*** (Nyl.) Coppins

28*. Ascospores ovoid, ellipsoid-ovoid or oblong, simple or 1-septate 29

29. Thallus endoxylic, inconspicuous or of greyish granular-areolae, never of small, green to dull olive-green goniocysts; epihymenium sharply delimited, dull olive-grey, K+ intensive violet 30

29*. Thallus of green to dull olive-green goniocysts 31

30. Thallus endoxylic or inconspicuous, visible as pale grey or olive-grey tinge of substrate, usually with stalked, black pycnidia; walls of pycnidia olive-gray or olive-brown, K+ violet; apothecia greyish-black to black but in many cases not developed; ascospores 0(–1)-septate, ovoid; no substances detected by TLC ..... ***M. misella*** (Nyl.) Hedl.

30*. Thallus morphologically blackish, inconspicuous or of greyish granular-areolae; apothecia black; pycnidia numerous, black, usually emergent, shortly stalked or sessile; ascospores narrowly ovoid and ellipsoid, (0–)1-septate; micareic acid present ..... ***M. nowakii*** Czarnota & Coppins

31. Pycnidia numerous, stalked, ± brown, whitish tomentose; walls K+ violet; goniocysts containing orange-brown droplets, K+ violet; apothecia brown, often tuberculate; no substances detected by TLC ..... ***M. hedlundii*** Coppins

31*. Micareic or methoxymicareic acid present ... 32

32. Micareic acid present; apothecia convex-hemisphaerical or subglobose, very variable in colour, whitish-grey, pale brown, brownish-grey, grey-black or black; pycnidia whitish, olive-black or black, sessile or immersed between goniocysts ..... ***M. prasina*** Fr.

32*. Methoxymicareic acid present; thallus more or less olive; apothecia subglobose to shallow-convex or adnate, whitish grey to dark grey (at least with greyish tinge) 33

33. Thallus pale olive; apothecia convex to subglobose, small 0.1–0.2 mm, whitish grey to piebald; numerous punctiform whitish to greyish pycnidia usually present ..... ***M. micrococca*** s.l.

33*. Thallus dull olive, apothecia shallow-convex to adnate, grey to lead coloured, 0.2–0.5 mm; pycnidia rare with greyish walls ..... ***M. byssacea*** (Th. Fr.) Czarnota & Guzow-Krzemińska

34. Thallus of whitish-grey, convex to subglobose areolae; apothecia brown to brown-black, usually ± globose; epithecium brown, in K dissolving and fading into solution .... ***M. elachista*** (Körb.) Coppins & R. Sant.

34*. Thallus not composed of subglobose areolae, apothecia pale, brownish or orange-brown 35

35. On acidic rocks; apothecia pale, hyaline inside, only in exposed localities yellowish-orange to orange-brown and then hypothecium orange-gold, K–; ascospores simple, ovoid ..... ***M. lithinella*** (Nyl.) Hedl.

35*. Not on rocks 36

36. Pycnidia stalked with whitish tomentum at least in lower part; walls brown K– or K± violet; thallus of small, bright green granules; apothecia pale or pallid straw-brown, hyaline inside ..... ***M. tomentosa*** Czarnota & Coppins

36*. Without tomentose pycnidia 37

37. Thallus endoxylic or inconspicuous; apothecia pale orange, orange-brown; some parts of hymenium brownish, K± dulling; pycnidia shortly stalked, walls brown, K+ dulling .... ***M. anterior*** (Nyl.) Hedl.

37*. Thallus of pale to dull green goniocysts, or thallus grey-green, waxy in appearance 38

38. Thallus ± continuous, waxy in appearance; apothecia pale straw, pale straw-brown, adnate to clustered, often with a white rim; sporodochia bearing macroconidia 6–9 × 2–3 μm diam. usually present ..... ***M. adnata*** Coppins

38*. Thallus of goniocysts 39

39. Methoxymicareic acid present; apothecia shallow-convex, pallid; usually with numerous, small, white, sessile and gaping pycnidia; paraphyses numerous; narrow excipulum usually present ..... ***M. micrococca*** s.str. (Körb.) Gams *ex* Coppins

39*. Micareic acid present; apothecia convex, hemispherical or subglobose, pallid; paraphyses rather scanty; excipulum never developed..... ***M. prasina*** Fr.

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