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Micarea doliiformis (Pilocarpaceae, lichenized Ascomycota) – a first record for Russia and Asia from Dagestan (East Caucasus)

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Keywords: biogeography, broad-leaved forest, new records, lichens, Samursky National Park.

Summary. *Micarea doliiformis* is reported as new to Russia and Asia from the broad-leaved floodplain forest of the Samur River delta. Our record considerably extends the eastern range of the species from its previously known Western European-Atlantic distribution. A detailed description of the specimen with ecological preferences is given. The main difference from similar species with white-tomentose pycnidia (*Micarea hedlundii* and *M. tomentosa*) is larger, non-micareoid photobiont and the mostly biguttulate conidia which are wider at one end. Other morphological, anatomical, chemical and ecological differences between similar species are discussed.

Micarea doliiformis (Pilocarpaceae, лихенизированные Ascomycota) – первая находка для России и Азии из Дагестана (Восточный Кавказ)

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Ключевые слова: биогеография, лишайники, Самурский национальный парк, флористические находки, широколиственный лес.

Аннотация. Приводится новый для России и Азии вид *Micarea doliiformis*, обнаруженный в широколиственных лесах дельты реки Самур. Находка вида в Дагестане значительно расширила на восток границы его ареала от ранее известного западноевропейско-атлантического распространения. Дается подробное описание образца, обсуждаются морфологические, анатомические, химические и экологические различия схожих видов. Основным отличием от видов с белыми опушенными пикнидиями (*Micarea hedlundii* и *M. tomentosa*) является крупноклеточный не микареоидный фотобионт (до 14 мкм в диам.), а также сужающиеся к одному концу двухкапельные конидии.

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Introduction

The genus *Micarea* Fr. comprises more than 140 species worldwide (Kantelinen et al., 2024). It is crustose mainly lignicolous or corticolous lichens which are common in boreal forests. Earliest taxonomic studies of the genus revealed a many variable groups within (Coppins, 1983). Recently molecular revisions and phylogenetic reconstructions have revealed greater diversity in *Micarea*, and a significant number of new species continue to be described from all parts of the world according to molecular data (e.g. van den Boom et al., 2017, 2020; Guzow-Krzemińska et al., 2019; Launis et al., 2019a, b; Kantelinen et al., 2024) or based on only morhpo-anatomical features and secondary metabolites (e.g. Elix, McCarthy, 2018; Kantvilas, Coppins, 2019; Coppins et al., 2021; van den Boom et al., 2023; Aptroot, Cáceres, 2024).

Most of the *Micarea* species are known from Europe as a result of intensive study (e.g. Coppins, 1983; Czarnota, 2007; Kantelinen et al., 2021, 2024). A large area of the Asian region is poorly studied (Konoreva et al., 2019). In the Caucasus, the genus *Micarea* is quite well represented, with 24 species (Urbanavichus, 2010; Urbanavichus, Urbanavichene, 2014; Ismailov et al., 2017, 2019; Urbanavichus et al., 2020), of which 9 species – *Micarea botryoides* (Nyl.) Coppins, *M. hedlundii* Coppins, *M. micrococca* (Körb.) Gams ex Coppins, *M. misella* (Nyl.) Hedl., *M. prasina* Fr., *M. pusilla* Launis, Malíček et Myllys, *M. soralifera* Guzow-Krzem., Czarnota, Łubek et Kukwa, *M. substipitata* Palice et Vondrák, and *M. tomentosa* Czarnota et Coppins have been reported in Dagestan in recent years (Ismailov et al., 2017, 2019).

During the field work in 2023 in broad-leaved forests of the Samur River delta, we found a corticolous specimen with dark grey, thinly white-tomentose stalked pycnidia belonging to *Micarea*. In Dagestan the group of species with similar pycnidia includes only *Micarea hedlundii* and *M. tomentosa*. Our specimen was not similar to either these species and had different features. Furthermore, species with similar features to our specimen were previously unknown throughout Asia.

Materials and Methods

Specimen identification was based on morphological, anatomical and chemical evidences with chemical spot tests and UV light. High Performance Thin Layer Chromatography (HPTLC) was performed according to standard methods summarized by Arup et al. (1993) in solvent system A and Camag glass plates with F254 layer. The wall pigments of the pycnidia were identified according to Meyer and Printzen (2000). Photographs were taken with the AxioCam 506 camera using the Zeiss Axio Scope A.1 microscope and the Zeiss Stemi 508 stereomicroscope at the Komarov Botanical Institute RAS. The distribution map was prepared using ArcGis 10.1. Geographical coordinates are given in the WGS 84 system. The specimen was deposited in the herbarium of the Altai State University (ALTB).

Habitat (Fig. 1):

The specimen was found in the floodplain broad-leaved liana forest on the Caspian Sea coast in the delta of the Samur River (Samursky National Park). This territory refers to the lowland Dagestan and is located in the transition zone from warm temperate to subtropical climate. The average annual precipitation is only 400 mm, but air humidity is high (78 %) due to the close vicinity of the Caspian Sea, the dense river network under the forest canopy and the high groundwater level. With an average temperature of 12.6 °C and lack of snow cover, this area is one of the mildest in lowland Dagestan (Gadzhieva, Solovyov, 1996). Dominated tree species are *Carpinus betulus* L., *Populus alba* L., *Quercus robur* L. The second tree layer is formed by *Acer campestre* L., *Alnus barbata* C. A. Mey., *Fraxinus excelsior* L. Undergrowth forms by *Cornus mas* L., *Corylus avellana* L., *Crataegus pentagyna* Waldst. et Kit., *Mespilus germanica* L. and lianas *Clematis vitalba* L., *Hedera pastuchowii* Woronow, *Periploca graeca* L., *Smilax excels* L., *Vitis silvestris* C. C. Gmel. In the herbal layer, *Euphorbia amygdaloides* L. and *Lonicera caprifolium* L. are the dominant species.

Results

Micarea doliiformis (Coppins et P. James) Coppins et Sérus., 2010, Bryologist 113(2): 339 (Fig. 2)

≡ *Lecidea doliiformis* Coppins et P. James, 1992, Lichenologist 24(4): 361.

Description. Thallus effuse, crustose, whitish-grey with dull green tint, forming small patches (to 3 cm width) on twigs. The thallus granules are poorly distinguishable and appear as a continuous thick crust. Photobiont not micareoid, the cells 8–13(14) µm wide. Apothecia were not observed in the specimen from Dagestan. According to Cannon et al. (2022), apothecia pale brown to pink, often faintly white-pruinose, 0.2–0.5 mm across, convex to sub-

globose, without a distinct proper margin. Proper exciple not developed; epithecium pale brown due to dense, small crystals dissolving in K; hymenium colourless or with pale brown vertical streaks, 45–50 µm high; paraphyses branched and anastomosing, 0.8–1 µm thick at mid-level, the apical cells up to

Fig. 1. Habitat of *Micarea doliiformis*.

2.5(3) µm wide; hypothecium reddish brown, K+ yellowish brown. Asci 8-spored, clavate to cylindrical-clavate, with an unstained wall and a K/I+ blue outer layer and apical dome, the latter with a non-amyloid, cylindrical axial mass. Ascospores 1-celled, hyaline, ovoid to oblong-ellipsoid, (7)8–11 × 2.7–3.7 µm. Pycnidia 90–150 µm wide, 160–270 µm tall, numerous, stalked, barrel-shaped, dark grey, thinly white-tomentose. The wall dull brown, K–, N+ reddish brown (N± red near the ostiole), "Cinereorufa-green" pigment. Conidia shortly oblong or wider at one end, mostly biguttulate, 3.5–4.5 × 1.5–1.8 µm. Spot tests: all spot test negative, UV–.

Substrate and ecology: on bark of *Acer campestre* twigs in floodplain broad-leaved liana forest in the delta of the Samur River.

Secondary metabolites: no substances detected by HPTLC.

Specimen examined: "Russia, Republic of Dagestan, Magaramkentskiy district, Samursky National Park («Delta Samura» cluster), on twigs of *Acer campestre* in broad-leaved liana forest, 20 m a. s. l. 41°52'44"N, 48°31'08"E. 08 V 2023. A. B. Ismailov" (ALTB).

Distribution (Fig. 3): Western European-Atlantic species with spotted distribution in areas of Western and Southern Europe with oceanic climate. Known from British Islands (Cannon et al., 2022), France (Roux et al., 2020), Portugal (van den Boom, 2017), Spain (van den Boom et al., 1995), Italy (Nimis, 2016), Madeira (van den Boom, 2015), and Canary Islands (van den Boom, Ertz, 2012).

Note: The studied Dagestan specimen is entirely consistent with the known description of the species (Cannon et al., 2022).

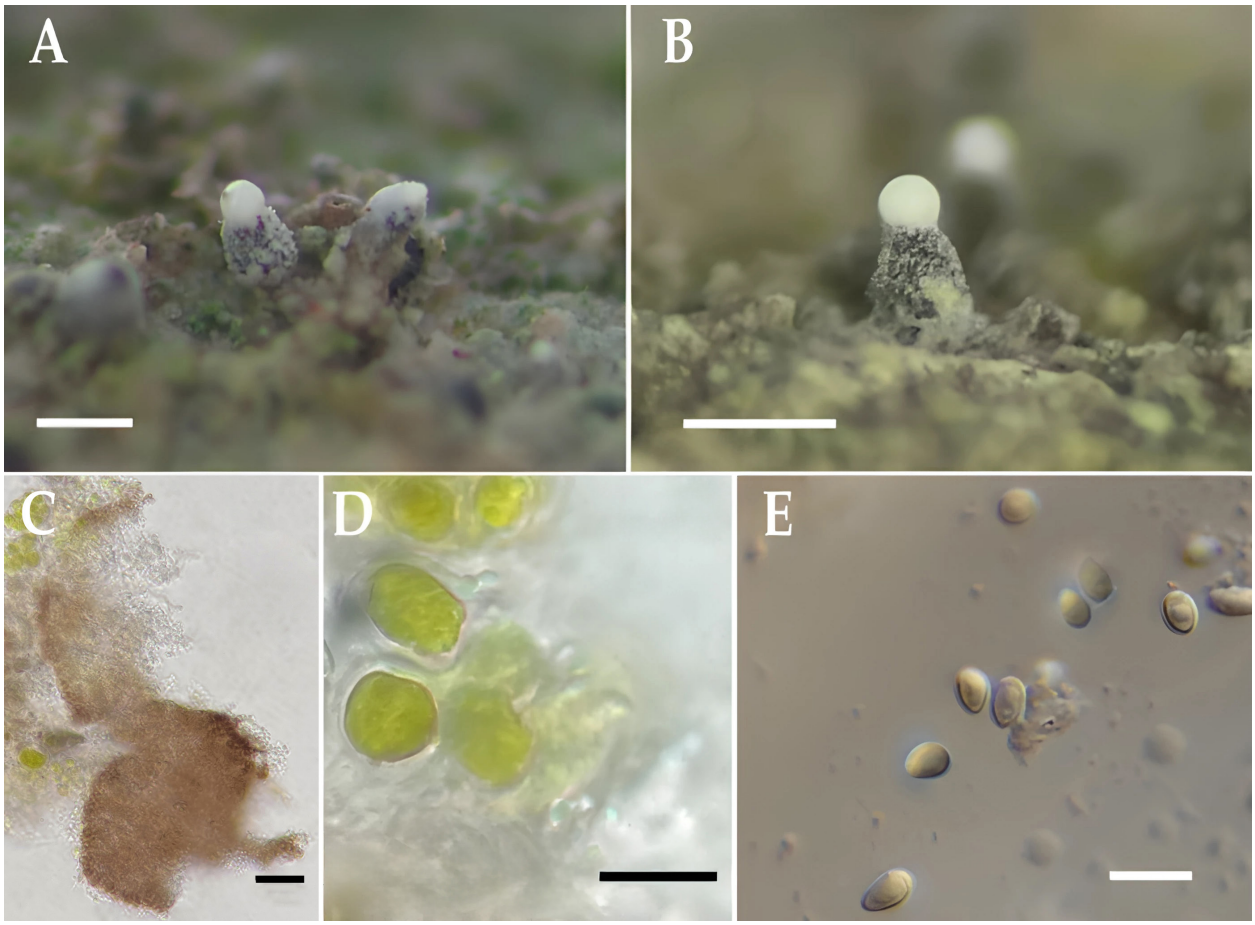

Fig. 2. A, B – pycnidia of *Micarea doliiformis*; C – reddish brown reaction of pycnidia wall with N; D – photobiont cells; E – conidia. Scale bars: A, B – 0.2 mm; C – 50 µm; D – 15 µm; E – 5 µm.

Discussion

Micarea doliiformis was described in 1992 as *Lecidella doliiformis* (Coppins et al., 1992). Further molecular studies resolved it to *M. assimilata* group and considered a distinct taxon (Sérusiaux et al., 2010). The main difference from other *Micarea* species with stalked pycnidia is a larger-celled non-

micareoid photobiont (to 14 μm diam) and wider at one end, mostly biguttulate conidia. Similar species with white tomentose pycnidia are *M. hedlundii* and *M. tomentosa* from the *M. prasina* group. The first one is distinguished by K+ violet ("Sedifolia-grey" pigment) reaction of pycnidia wall, sometimes branched pycnidia and containing orange-brown droplets (K+ violet, "Intrusa-yellow" pigment) in gelatinous matrix of goniocysts. The second one has a brighter coloured, more continuous thallus composed of larger granules, sessile to shortly stalked pycnidia and shorter conidia. There are also differences by ecology. *Micarea hedlundii* mostly grows on soft lignum of decaying stumps or rarely on damp sandstone (Czarnota, 2007; Cannon et al., 2022). *Micarea tomentosa* usually grows on decaying wood (stumps and logs), rarely on bark at the base of old trunks of coniferous and deciduous trees (Czarnota, 2007). According to the substrate preferences of *M. doliiformis,* the species seems to be more corticolous. In Italy, it has been recorded on the bark of *Olea* (Nimis, 2016), in the British Islands – on the bark of *Quercus* in particular or on long-exposed wood (Cannon et al., 2022), in France – on the bark of deciduous and coniferous trees or lignicolous (Roux et al., 2020), in Spain – on the rotting wood (van den Boom et al., 1995), in Madeira – on *Cryptomeria* trunk (van den Boom, 2015), in Portugal – on the trunks of *Grevillea*, *Thuja*, and *Cupressus* (van den Boom, 2017). Our record on twigs of *Acer* also suggests a bark preference of this species.

Micarea doliiformis is reported as rare in the literature, but this rarity is probably due to the fact that it is an unspectacular species that needs to be systematically searched for; it is also due to the fact that sterile thalli without apothecia are common and can only be recognized by their pycnidia, which require the use of a strong magnifying glass in the field. On the other hand, *M. doliiformis* is a rare and threatened species occurring mainly in natural, unmanaged woodlands. It is listed as "Critically Endangered" in the Italian Red List of epiphytic lichens (Nascimbene et al., 2013) and as endangered species in France (Roux et al., 2020). In the British Islands, where many records have been made, the species is locally restricted to the West and South but extends through Wales to W Scotland, with scattered occurrences in the uplands of Ireland (Cannon et al., 2022). Our record is also referred to the undisturbed forest area of the Samursky National Park.

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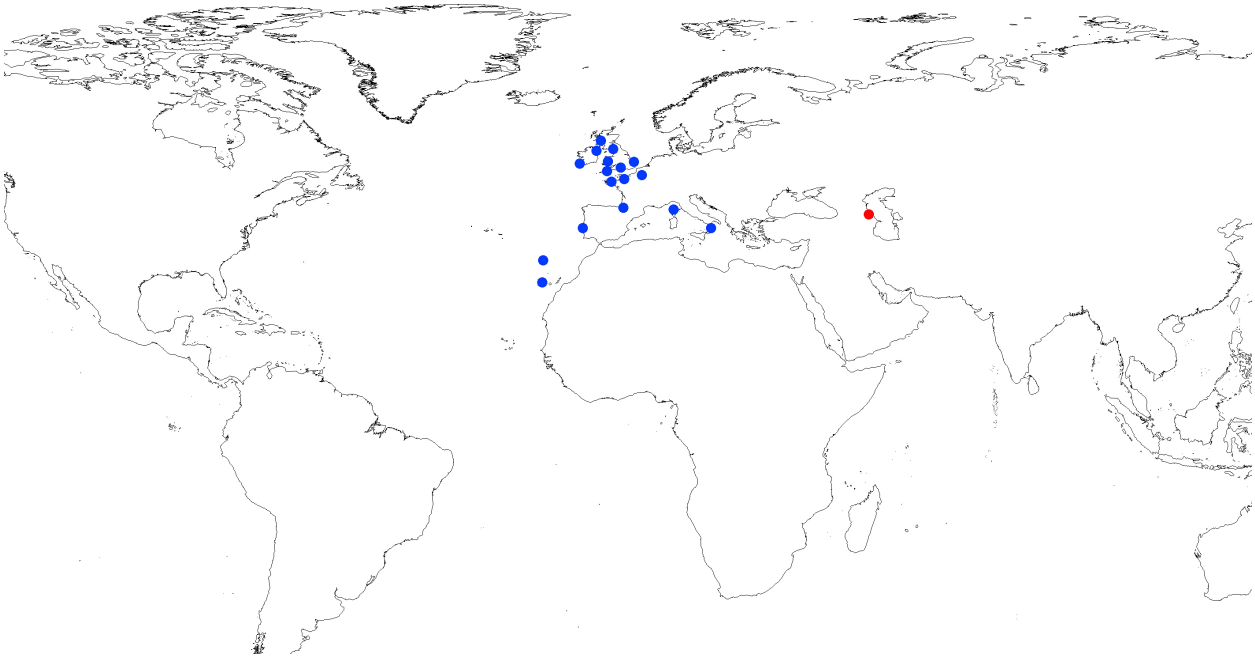

Fig. 3. Distribution map of *Micarea doliiformis*.

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